United States Army Aviation Logistics School
Fort Eustis, Virginia

APRIL, 1994

THIS DOCUMENT HAS BEEN REVIEWED FOR OPSEC CONSIDERATIONS

STUDENT HANDOUT

ROTOR SYSTEMS AND VIBRATIONS

071-630-16

The proponent for this SH is USAALS

TERMINAL LEARNING OBJECTIVE:

At the completion of this lesson you will:

ACTION: Analyze rotor system malfunctions.

CONDITIONS: Given the Operator's Manual for RADS-AT, TM 1-1500-204-23 series manuals, TM 1-1520-238-T series manuals, TM 55-1520-238-23 series manuals, TM 55-1520-238-10, TM 55-1520-238-CL, TM 55-1520-238-MTF, and a requirement to analyze rotor systems malfunctions.

STANDARDS: Identify by selecting from a list, characteristics of the rotor systems and vibration analysis procedures, with a minimum of 70% accuracy.

SAFETY REQUIREMENTS: In addition to the specific safety requirements of this lesson plan, aviation shop and flight line safety standards established in the technical manuals will be reinforced.

RISK ASSESSMENT LEVEL: Low

ENVIRONMENTAL CONSIDERATIONS: None

EVALUATION: This lesson will be evaluated during practical written evaluation 9C7-515-04.

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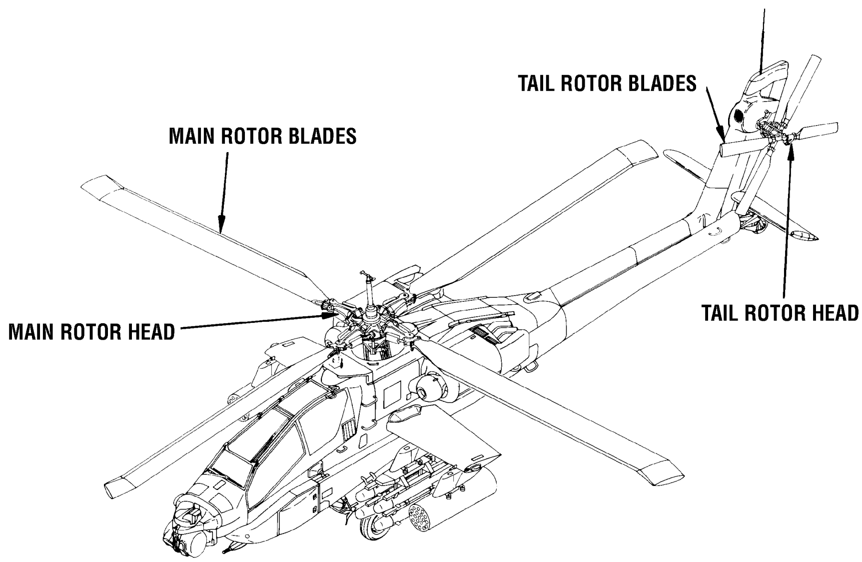
AH-64A ROTOR SYSTEM



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NOTES

A. AH-64A rotor system

1. Purpose - Provides lift, thrust, directional flight and anti-torque control for the helicopter.

2. Major components

a. Main rotor assembly

b. Tail rotor assembly

c. Controls and indicators

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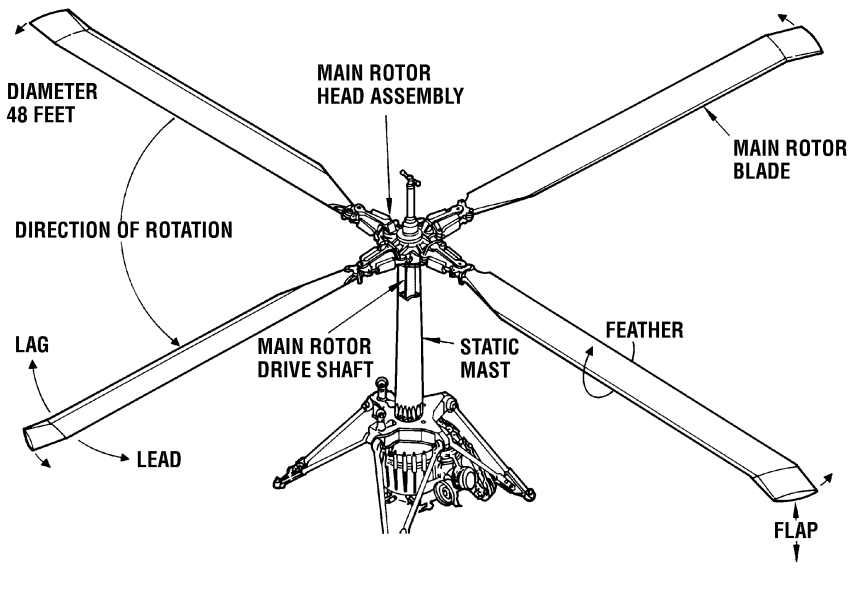
MAIN ROTOR ASSEMBLY



NOTES

B. Main rotor assembly characteristics

1. Purpose - Provides for lift and directional flight for the helicopter.

2. Location - Mounted on the static mast above the main transmission.

3. Description

    a. Uses a single, four-bladed, fully articulated main rotor assembly.

    b. Diameter - 48 feet

    c. Counterclockwise rotation

    d. Does not require periodic lubrication

    e. Flight loads are transferred from the main rotor via the static mast, mast base support, and support struts into the airframe.

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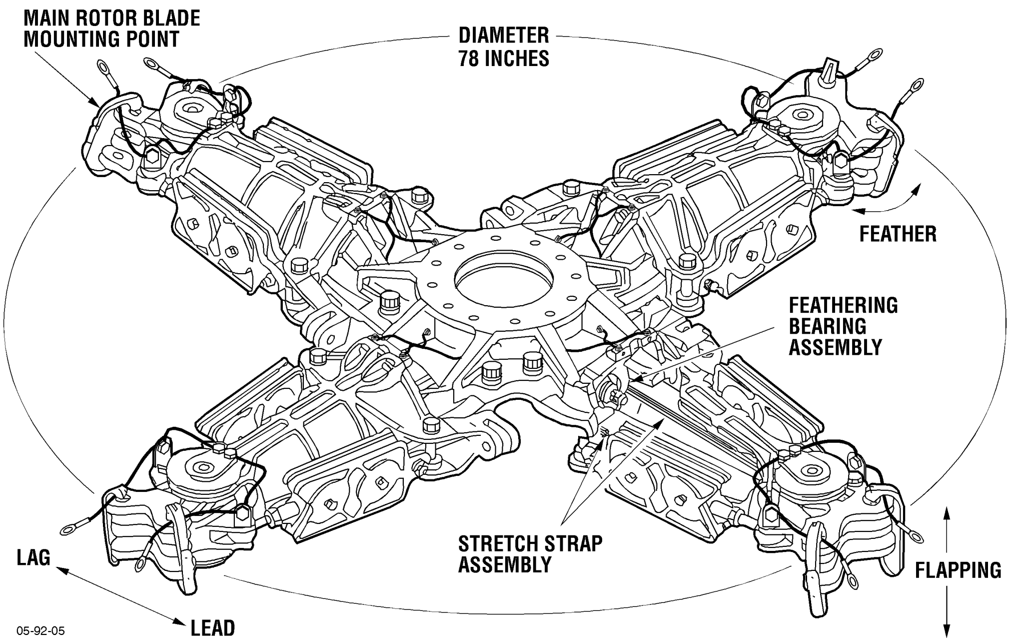
MAIN ROTOR HEAD ASSEMBLY



NOTES

C. Main rotor assembly components

1. Main rotor head assembly

a. Purpose - Provides the means for mounting, driving, and controlling the main rotor blades and provides for feathering, flapping, and lead-lag movement of each individual blade.

b. Description

(1) Weighs approximately 607 pounds

(2) Approximately 78 inches in diameter

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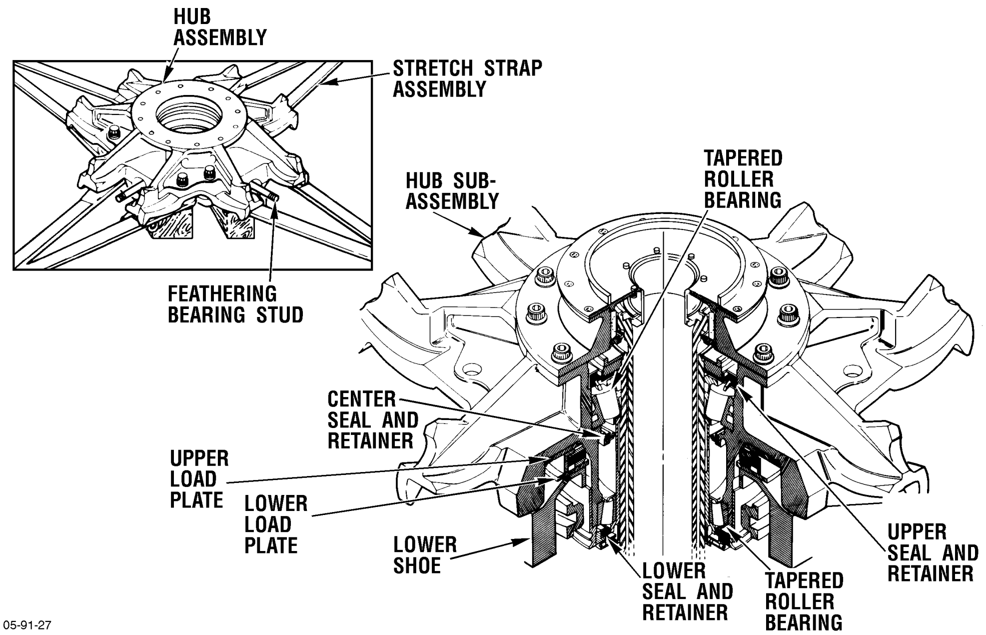
MAIN ROTOR HUB ASSEMBLY CUTAWAY (1)



NOTES

c. Major components

(1) Hub assembly

(2) Seals, and retainer (upper, center, and lower)

(3) Tapered roller bearings (upper and lower)

(4) Upper and lower load plates

(5) Stretch strap assembly

(6) Lower shoe

(7) Feathering bearing stud

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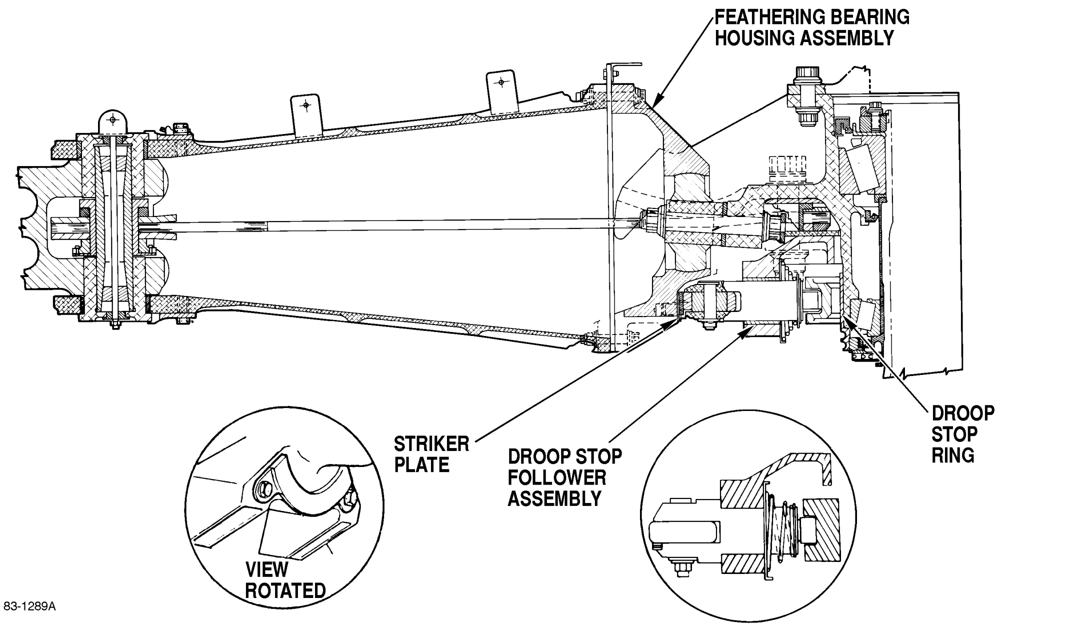
DROOP STOP FOLLOWER ASSEMBLY AND FEATHERING BEARING HOUSING ASSEMBLY



NOTES

(8) Droop stop follower assembly

(9) Droop stop ring

(10) Feathering bearing housing assembly

(11) Striker plate

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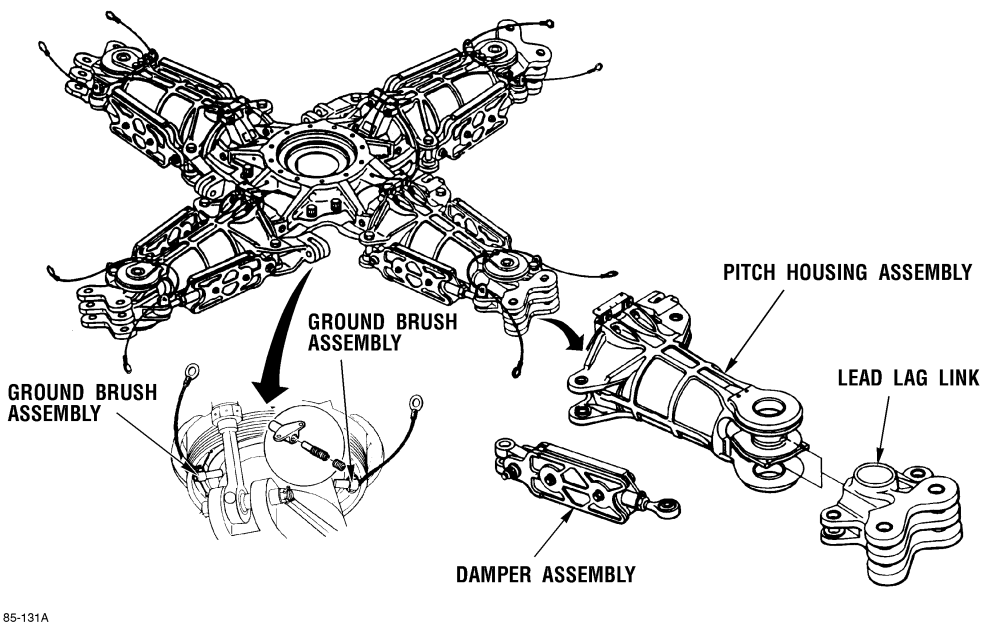
MAIN ROTOR HEAD ASSEMBLY DESCRIPTION



NOTES

(12) Pitch housing assembly

(13) Lead-lag link

(14) Main rotor damper assembly

(15) Ground brush assembly

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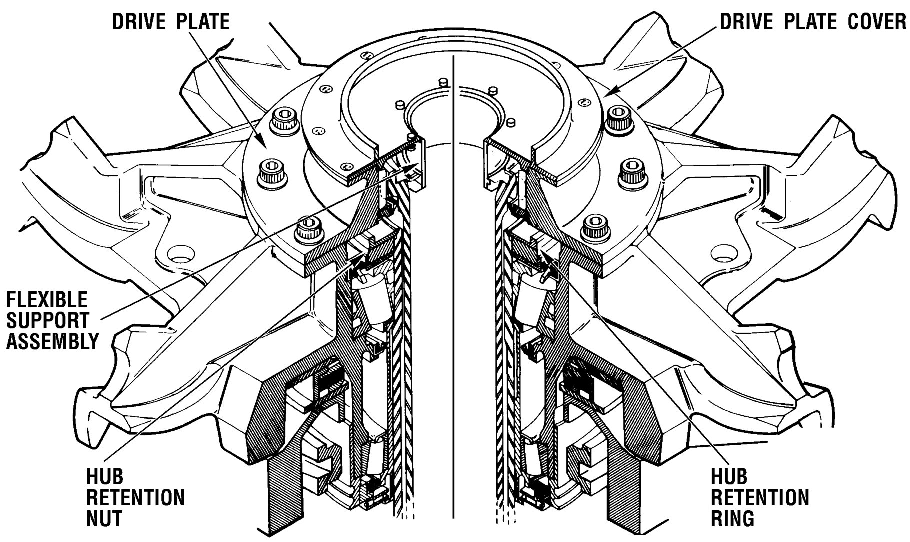
MAIN ROTOR HUB ASSEMBLY CUTAWAY (2)



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NOTES

(16) Hub retention nut and hub retention ring

(17) Drive plate

(18) Flexible support assembly

(19) Drive plate cover

(20) Main rotor bearing nut plug assembly (not shown). ECP 1107 eliminates the plug assembly and the hole in the drive plate where the plug assembly was installed. Moisture entering into this hole was causing corrosion.

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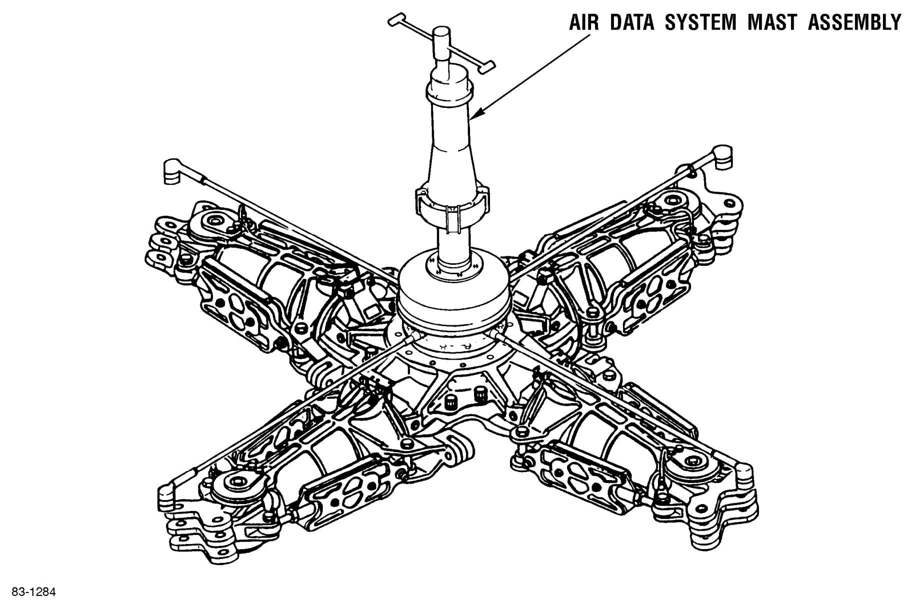
AIR DATA SYSTEM MAST ASSEMBLY



NOTES

(21) Air data system mast assembly

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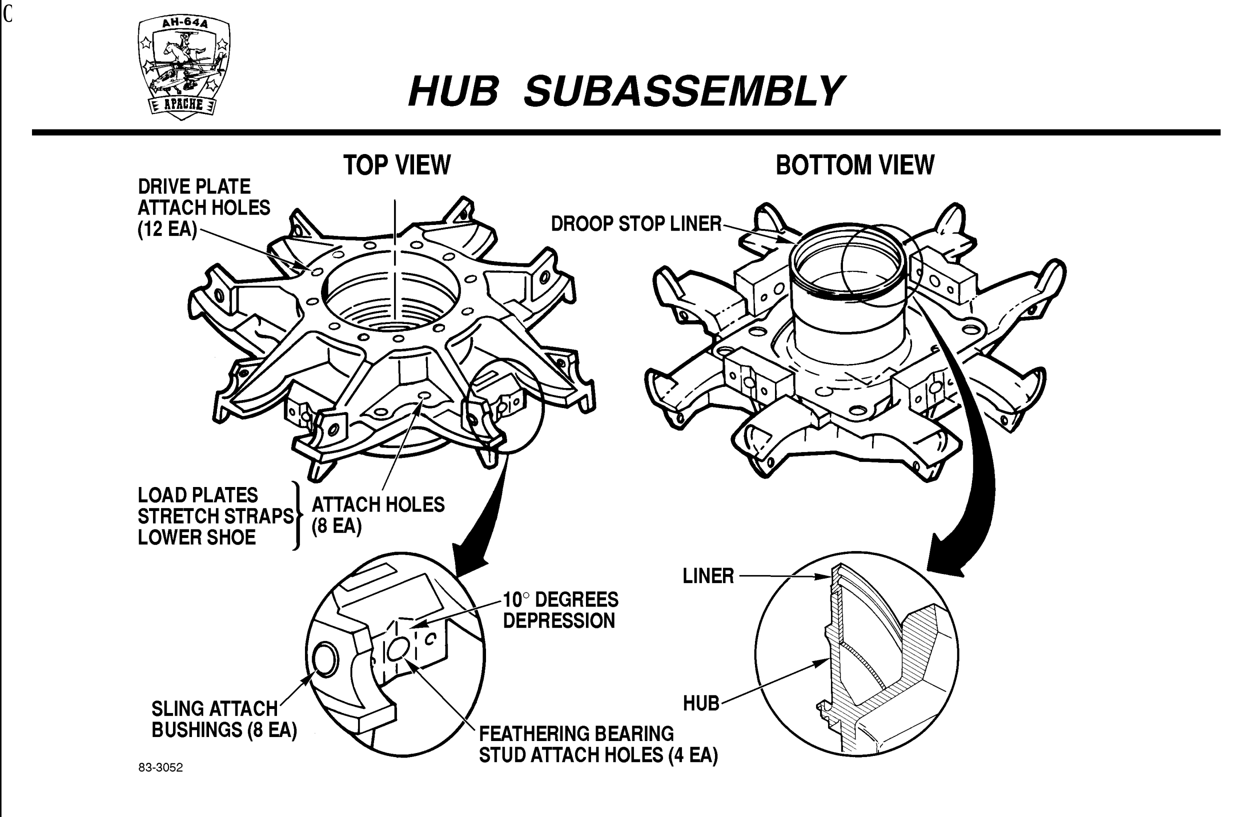
HUB SUBASSEMBLY
TOP VIEW
BOTTOM VIEW
DRIVE PLATE
ATTACH HOLES
(12 EA)
DROOP STOP LINER
LOAD PLATES
STRETCH STRAPS
LOWER SHOE
ATTACH HOLES
(8 EA)
LINER
10° DEGREES
DEPRESSION
HUB
SLING ATTACH
BUSHINGS (8 EA)
FEATHERING BEARING
STUD ATTACH HOLES (4 EA)
83-3052

NOTES

D. Main rotor head assembly component characteristics

1. Hub subassembly

a. Provides for attachment of the upper and lower load plates, the stretch strap assembly, and lower shoe.

b. Provides alignment points (feathering bearing studs) for the pitch housing assembly feathering and flapping axis.

c. The hub is a webbed shaped aluminum alloy forging with a droop stop liner.

d. The upper portion contains twelve equally spaced holes for the drive plate attachment.

e. The webbed portion has eight holes to attach the load plates, strap packs, and lower shoe.

f. Eight corrosion resistant steel bushings are installed into the hub for attachment of the aircraft lifting sling.

g. The main rotor head configuration as shown in slide # 9, is subject to corrosion because of the dissimilarity of mating materials. The rotor drive plate is nitralloy vacuum cad plated. The hub subassembly is aluminum alloy chemical finished and painted.

(1) Two solutions have been implemented in order to correct this problem.

(a) The earlier model helicopters have a corrosion resistant steel shim installed between the top facing surface of the hub-subassembly (P/N 7-311411003) and the drive plate. Main rotor heads with this configuration are designated P/N 7-311411003-609.

(b) Later model helicopters have a modified hub-subassembly (P/N 7-311411003-3) which is identical to the previous ones except for an aluminum bronze plasma spray on the top facing surface. This eliminates the need for the corrosion resistant steel shim. The coating provides the corrosion protection between the hub subassembly and drive plate. The designation for the main rotor head with this type of corrosion preventative measure is P/N 7-311411003-607.

(2) The main rotor heads, as well as the hub-subassemblies are one way interchangeable. The hub-subassembly P/N 7-311411003 can be reworked.

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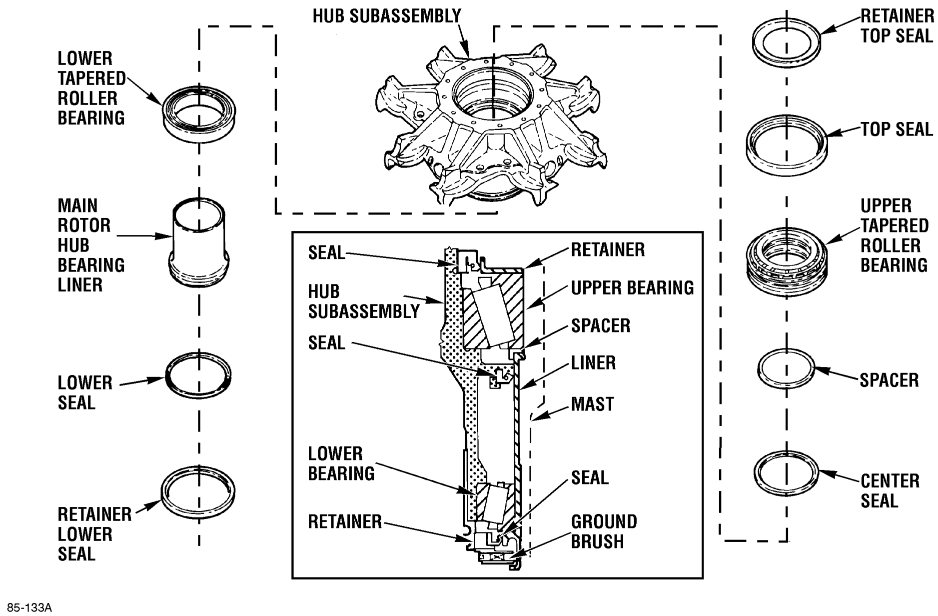
SEALS AND TAPERED ROLLER BEARINGS



NOTES

2. Seals and retainers (upper, center, and lower)

   a. Prevent grease from leaking past the upper and lower tapered roller bearings.

   b. The upper seal is mounted into the hub subassembly between the upper tapered roller bearing and the hub retaining nut. It is held in place by a retainer.

   c. The center seal is mounted into the hub subassembly between the upper tapered roller bearing and the lower tapered roller bearing.

   d. The lower seal is mounted into the hub subassembly below the lower tapered roller bearing and held in place next to the M/R hub bearing liner by a retainer.

   e. The upper seal comes in two different configurations depending on the manufacturing source. One consists of a steel case assembly which houses a spring and sealing element. The other is similar, but without the spring.

   f. The center and lower seals consist of a steel case assembly which houses a spring and sealing element.

   g. The upper retainer is a corrosion resistant steel plate assembly.

   h. The lower retainer is an aluminum alloy plate and consist of

      (1) Eight threaded holes, four of which extend through the plate. The other four extend approximately 3/4 the way into the plate.

      (2) The holes that extend through the plate are used to install socket head screws to perform removal procedures. During installation the holes are plugged.

      (3) The holes that are partially threaded provide mounting for the ground brush assemblies.

3. Tapered roller bearings (upper and lower)

   a. Installed on the hub subassembly to carry the radial and axial loads allowing the main rotor head to rotate around the static mast smoothly.

   b. The upper tapered roller bearing is installed between the upper and center seals and rests on the hub, a spacer and static mast.

   c. The lower tapered roller bearing is installed above the lower seal on the hub subassembly and the static mast liner.

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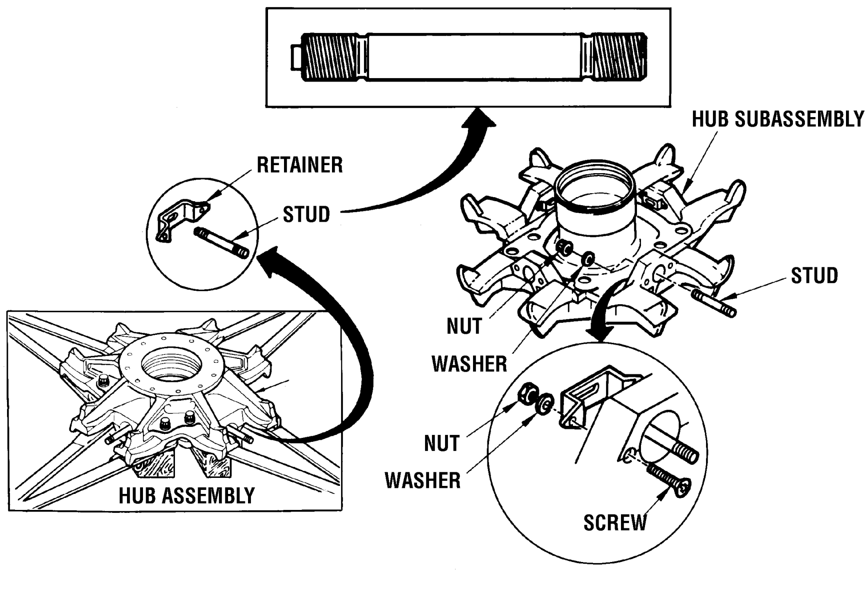
FEATHERING BEARING STUD



NOTES

4. Feathering bearing stud

a. The feather bearing stud is mounted to the hub subassembly and secures the feathering bearing housing assembly to the hub subassembly.

b. Four studs are mounted diametrically opposed on the hub subassembly.

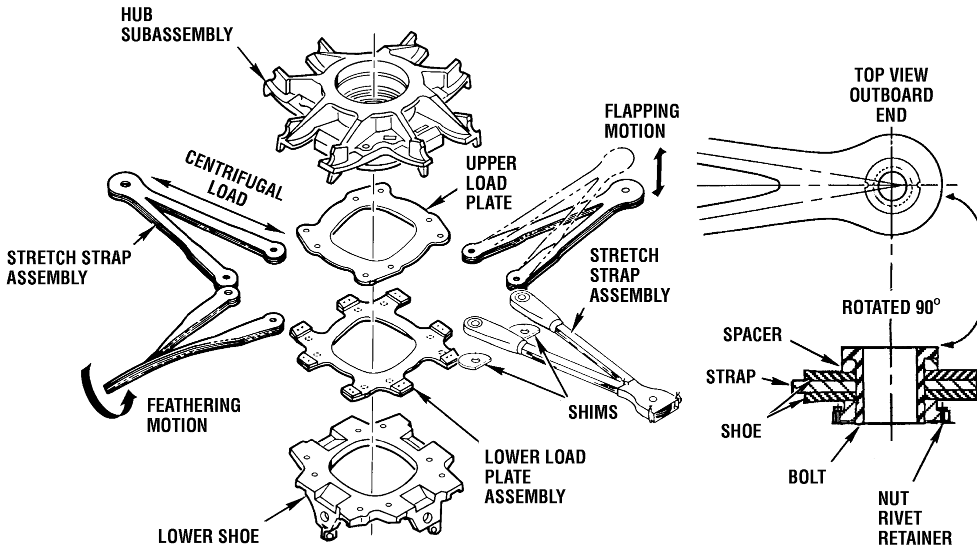
c. The steel stud consists of threaded portion at both ends. The inboard end aft of the threads forms a rectangular key section.

d. The stud is secured to the hub subassembly by a nut and washer. Once the stud is torqued, a retainer (bracket) assembly is installed to prevent the stud from rotating.

e. The stainless steel retainer has a cut-out portion for the rectangular key end of the stud to set in. It is installed to the hub via two screws, nuts, and washers.

C

HUB ASSEMBLY EXPLODED VIEW



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NOTES

5. Upper and lower load plates

   a. Provide the interconnection of the stretch strap assembly to the hub.

   b. Carries the centrifugal loads received from the main rotor blades through the stretch strap assembly to the hub.

   c. Installed between the hub subassembly and the lower shoe.

   d. The upper load plate is a heat treated steel element with eight holes for securing the plate to the hub.

6. Stretch strap assembly

   a. Transmits centrifugal loads from the main rotor blades to the hub and provides for pitch change, flapping, and feathering motion of each individual blade.

   b. Mounted between the upper and lower load plates at the hub subassembly and lower shoe clamp up. It passes through the pitch housing assembly to the lead-lag link, where it is attached by the hinge pin.

   c. Consists of 22 stainless steel laminates (0.016) stacked one on top of the other to form a V-shape.

   d. The inboard portion consists of two mounting points; the laminates at these points are clamped together utilizing a hollow close tolerance bolt, washers, shim, and nut.

   e. The laminates at the mounting points have a corrosion resistant steel abrasion strip at the top and bottom of the stack-up. These extend outward approximately 6.5 inches. Each laminate is separated by a spacer and a teflon strip at the mounting point. A piece of cellophane also separates each laminate; this is used in bonding the teflon to each laminate for no metal to metal rubbing.

   f. The outboard portion consists of a single mounting point. The laminates are clamped together utilizing a hollow close tolerance bolt, spacer (titanium) nut, a retainer and four rivets.

   g. Twists along its entire length allowing the main rotor blade to feather.

   h. Flexes, allowing the main rotor blade to flap.

   i. ECP 1048 made changes to the stretch strap assembly to improve service life. This included a 0.002 quarter-hard 301 CRES spacer and an outboard shoe of titanium.

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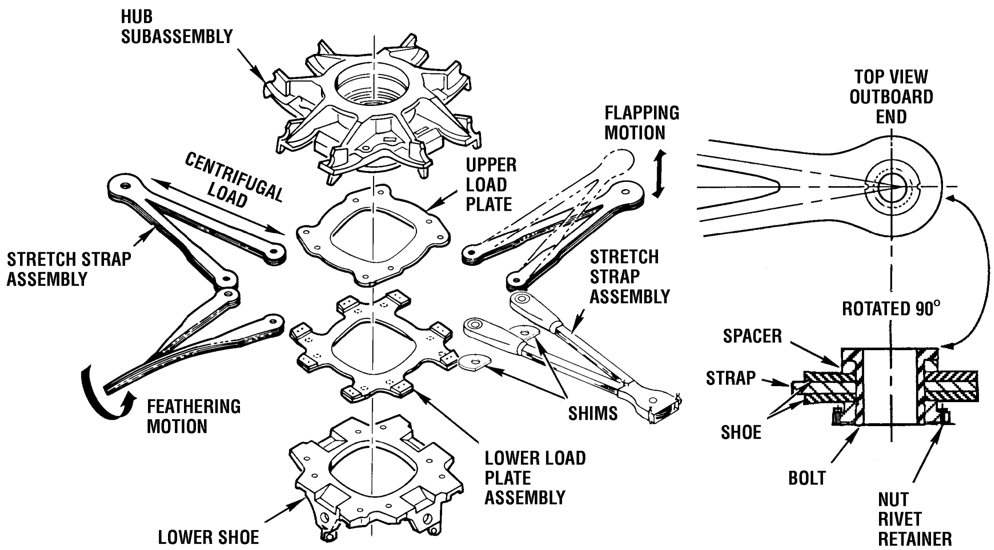
HUB ASSEMBLY EXPLODED VIEW



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NOTES

7. Lower shoe assembly

   a. Secures the upper and lower load plates and the stretch strap assemblies to the hub assembly.

   b. Provides the attachment lugs to drive the scissors assemblies.

   c. Provides housing ports for the droop stop follower assemblies.

   d. Mounted to the lower part of the hub assembly.

   e. The assembly is an aluminum alloy forging which contains eight holes drilled into the mating surface for securing to the hub subassembly.

   f. The lower portion consists of two clevis like assemblies located 180 degrees apart. Each clevis assembly contains two journal type bearings. They provide installation of the scissors assemblies (the scissors assemblies will be discussed during the Flight Controls Lesson).

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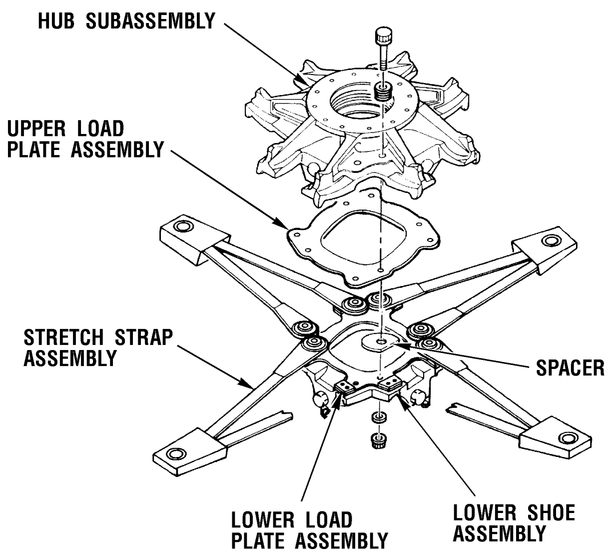
SECURING STRETCH STRAP ASSEMBLY (1)



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NOTES

8. Securing stretch strap assembly

   a. The hub subassembly, upper load plate, and lower show assembly contain a raised area on their respective mating surfaces (index mark). Ensure index marks are aligned.

   b. Ensure spacers (shims) are installed between lower load plate and strap assemblies in the same location as removed.

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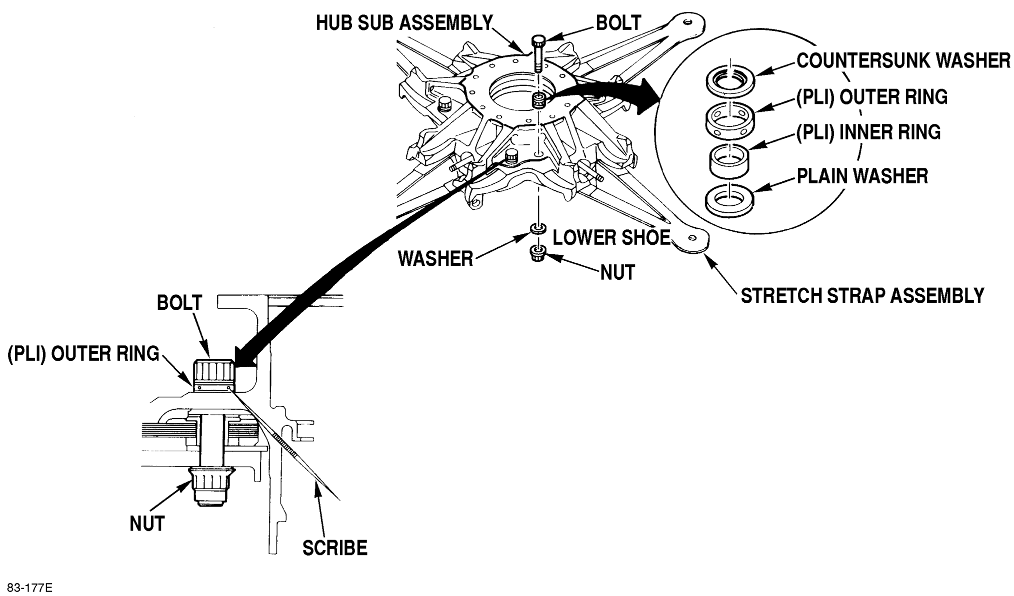
SECURING STRETCH STRAP ASSEMBLY (2)

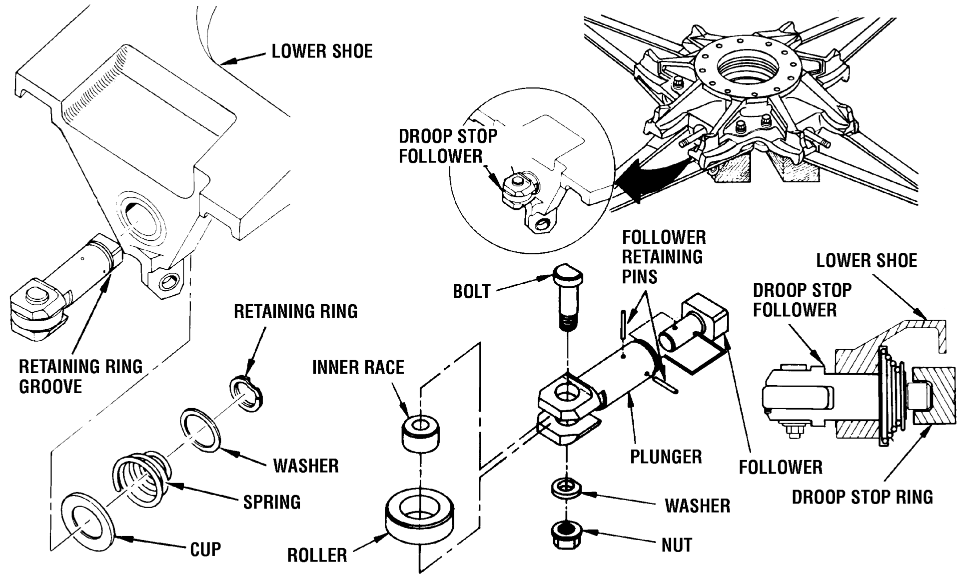


NOTES

c. Special pre-load indicating washer sets (PLI washers) are used to secure the lower shoe, lower load plate assembly, stretch strap assembly, and upper load plate to the hub subassembly.

C

DROOP STOP FOLLOWER ASSEMBLY



NOTES

9. Droop stop follower assembly

   a. Restricts downward blade flap excursion (one blade down, opposite blade up)

   b. Limits downward coning (all blades down simultaneously)

   c. Installed in the lower shoe assembly

   d. Held in position by the droop stop ring, striker plate, and spring tension

   e. The droop stop follower assembly consists of

      (1) Follower - sets in the droop stop ring and provides an interface between the stop ring and the plunger assemblies. Is machined from heat treated corrosion resistant steel and coated with tungsten carbide. The mating surface that contacts the droop stop ring is slightly chamfered. The follower is retained in the plunger by two steel pins.

      (2) Plunger - acts as a bearing surface to provide horizontal movement within the lower shoe and provides a housing for the roller and follower. It is approximately 4-3/4 inches long and constructed of an aluminum alloy material. The inboard end has a retaining ring groove. The outboard end is a clevis assembly.

      (3) Retaining pins

      (4) Roller - provides a mating surface between the striker plate (feather bearing housing) and droop stop follower assembly.

      (5) Retaining ring - secures the droop stop follower into the lower shoe assembly.

      (6) Washer

      (7) Spring - provides the force to keep the follower in the droop stop ring. It is a corrosion resistant steel, 3-1/2 to 4 coil spring.

      (8) Cup - provides the support for and houses the base of the spring assembly. The corrosion resistant steel cup is basically a washer with a raised lip around the outer diameter.

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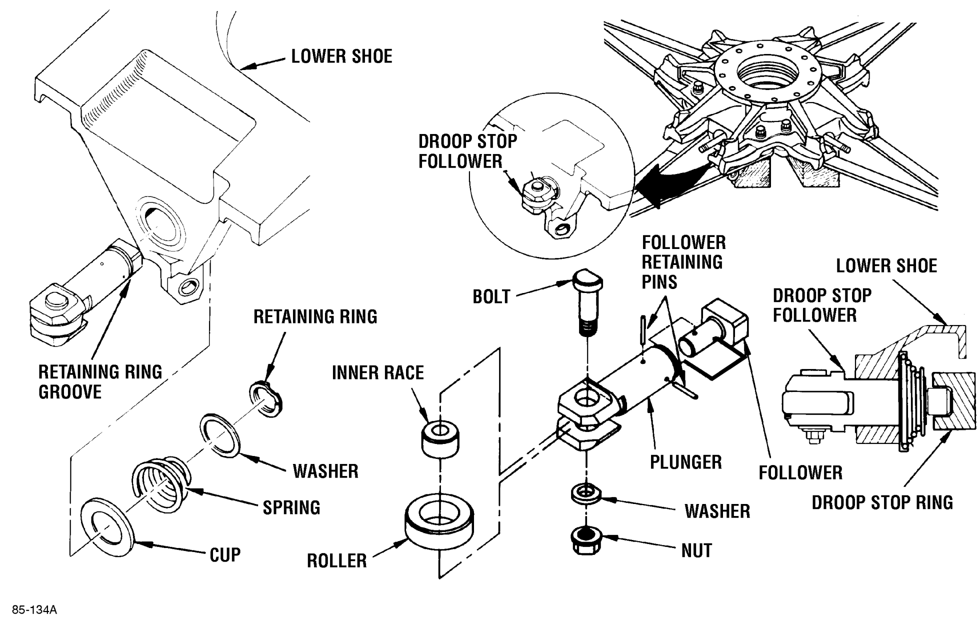
DROOP STOP FOLLOWER ASSEMBLY



NOTES

10. Droop stop ring

    a. Working in conjunction with the droop stop follower assembly, restricts main rotor blade downward coning and downward blade flap excursion

    b. Mounted in the lower portion of the lower shoe, and held in place by the four droop stop follower assemblies

    c. Machined from a heat treated corrosion resistant steel forging

    d. Inside diameter is approximately 10.6 inches

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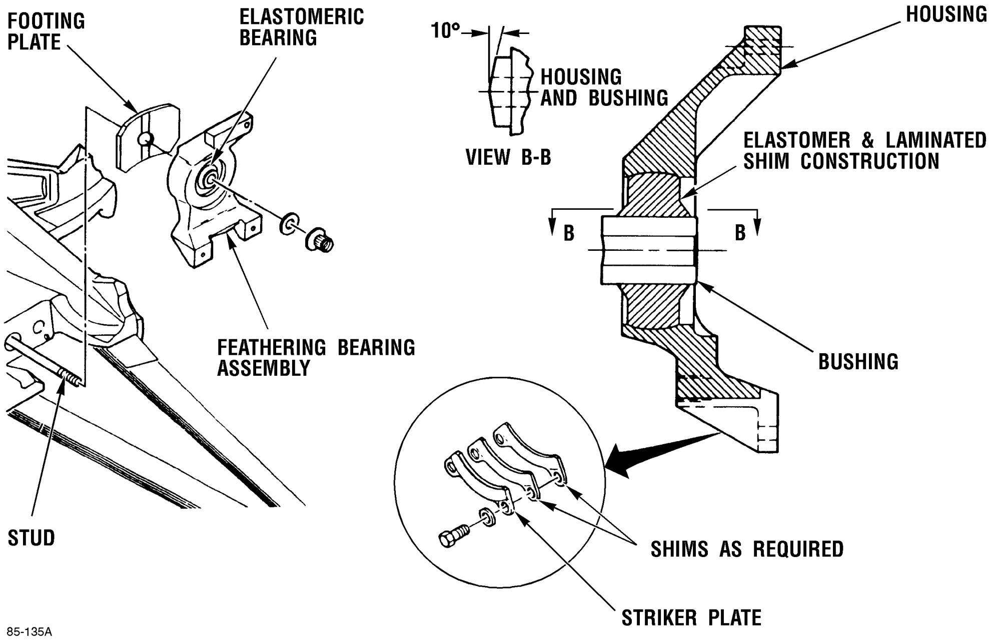
FEATHERING BEARING HOUSING ASSEMBLY



NOTES

11. Feathering bearing housing assembly (4)

    a. The elastomeric bearing provides for inner alinement (shear) of the main rotor blade flapping and feathering action.

    b. Provides the mounting point for the pitch housing assembly.

    c. Prevents lead/lag of the pitch housing assembly by rigidity of the strap assembly coupled with the elastomeric feathering bearing action.

    d. Mounted between the hub subassembly and the pitch housing, secured by the feathering bearing stud.

    e. An aluminum alloy housing with a spherical elastomeric bearing mounted in the center.

    f. The elastomeric bearing is an elastomer and laminated shim construction. An aluminum alloy bushing is bonded to the center of the bearing.

12. Striker plate

    a. Provides the contact surface for the droop stop follower assembly rollers to ride on during start-up, pitch changes, and shutdown.

    b. Provides the means for adjustment of blade static droop angle.

    c. Mounted to the lower inboard surface of the feathering bearing housing.

    d. A chamfered, heat treated, corrosion resistant steel plate approximately 0.220 inch thick.

    e. A corrosion resistant steel shim is used to properly adjust the M/R droop angle. The shim stock is 0.020 inch and can be peeled down to 0.002 laminate.

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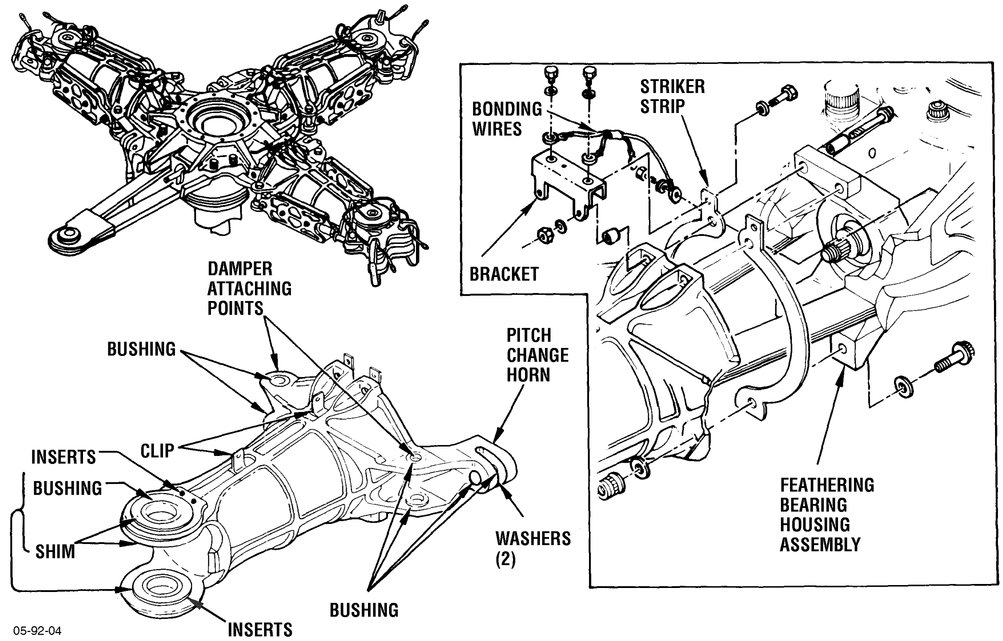
PITCH HOUSING ASSEMBLY



NOTES

13. Pitch housing assembly

a. Provides the means for controlling the main rotor blade pitch angle.

b. Provides for mounting and interfacing for the stretch strap assembly, (outboard end) lead-lag link, and the main rotor damper assemblies.

c. Attached to the feathering bearing housing assembly.

d. Material - is made of aluminum alloy.

e. Outboard portion provides mounting for the lead-lag link assembly and consists of two steel bushings ("shrink fit" installed), four steel shims (0.007) (shims are bonded and improve thrust load carrying capability of the pitch housing), and two threaded inserts.

f. Two clips are bonded along the center line of the top portion. They provide a means of securing the electrical wire harness that extends out to the blade for deice provisions.

g. The left and right inboard sections provide attachment points for the M/R damper assemblies. Each attachment point consists of two steel bushings ("Shrink fit" installed).

h. The extreme right inboard area is the pitch change horn and provides attachment for the pitch change link. Control inputs are transmitted to the integral pitch change horn by the pitch change link. The pitch link rotates the pitch housing on the feathering bearing. The attachment point has two steel bushings ("shrink fit" installed) and two nylon washers bonded to the inner mating surfaces. (Prevent abrasion.)

i. The pitch housing is secured to the feathering bearing housing at two points. An aluminum alloy striker plate is bonded to the left and right-hand side mating surfaces of the pitch housing which prevents damage to the housing assembly. A support bracket is installed at the upper mounting point of the striker plates for the deice wire harness.

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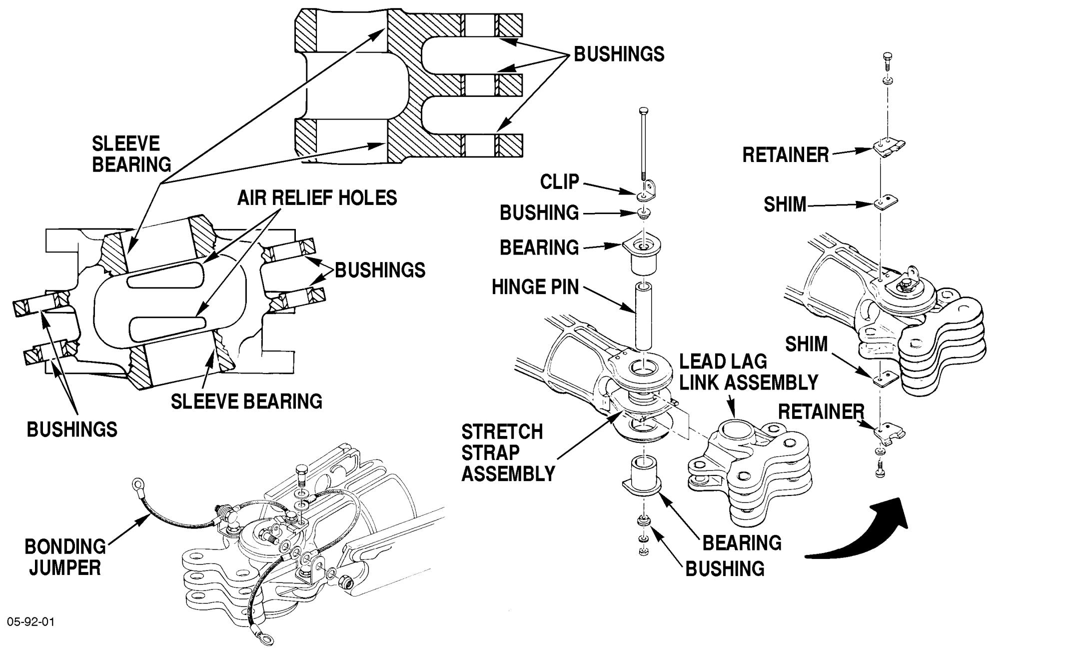
LEAD-LAG LINK ASSEMBLY, HINGE PIN AND BEARINGS



NOTES

14. Lead-lag link

a. Provides for mounting the main rotor blade.

b. Provides for lead-lag action of the main rotor blade.

c. Secures the outboard end of the stretch strap assembly and pitch housing assembly.

d. Mounted to the outboard end of the pitch housing.

e. Material - is made of titanium

f. Outboard section consists of three integral two point attachment lugs for securing the M/R blade. Each lug contains two aluminum bronze bushings.

g. Inboard section is comprised of two integral, single point attachment lugs for installing the M/R damper rod end bearing. Each lug contains an aluminum bronze bushing. (Upper is straight, lower is flanged.)

h. ECP 1242 creates new lead-lag link with air relief holes and field replaceable sleeve bearings. The air hole will improve serviceability by eliminating a dead end air pocket that collects dust, sand, and moisture, which accelerates wear on the teflon liners and initiates corrosion. The teflon liners are being replaced by the sleeve bearings.

i. Inboard center section consists of two integral single point attachment lugs for securing the stretch strap assembly and the lead-lag link to the pitch housing. Inner diameter of lugs from bearing surfaces, and are coated with a teflon type material.

j. Hardware for attaching lead-lag link consists of

(1) Bolt

(2) Clip - provides a mount point for securing deice harness.

(3) Bushing (2) - aluminum alloy

(4) Bearing (2) - a flanged aluminum alloy assembly which secures the hinge pin and allows the lead-lag assembly to pivot.

(5) Hinge Pin

(a) Retains the lead-lag link to the strap pack and provide a pivot point for leading and lagging.

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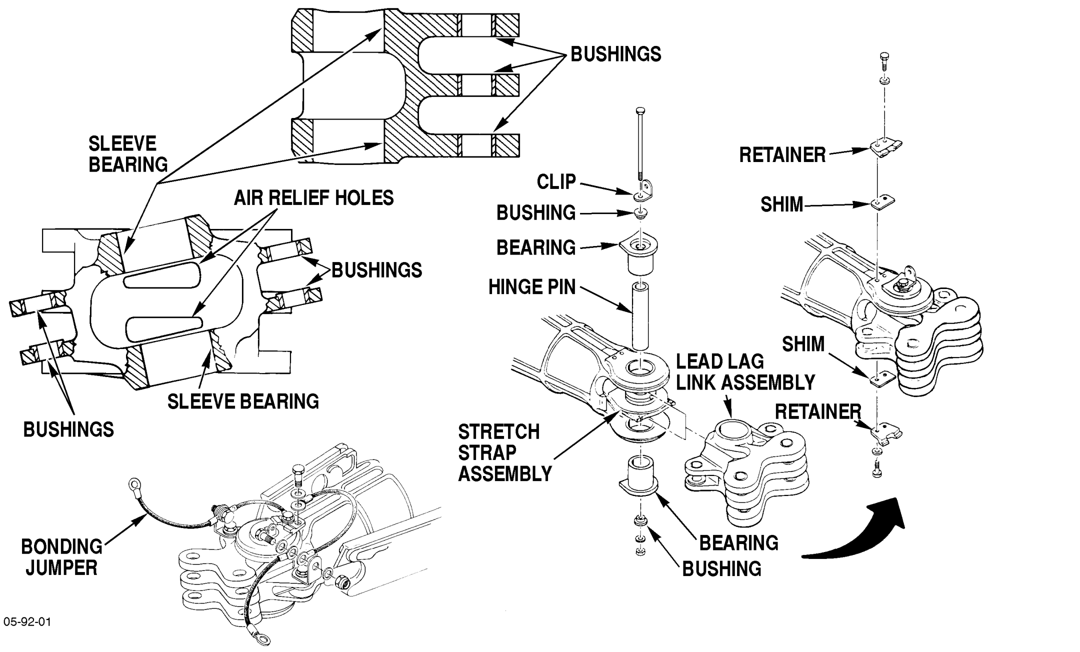
LEAD-LAG LINK ASSEMBLY, HINGE PIN AND BEARINGS



NOTES

(b) The pin is teflon coated and goes through the center of the link, pitch housing, and strap pack attaching holes. The pin itself is steel and hollow to reduce weight. An upper and lower bearing slide into the pitch housing around the pin. The inner bores are teflon coated. These bearings are held in position by bearing retainers. A bolt and clip goes through the two bearings.

(c) There must not be any interference between the retainers and bearings. Shims are used to provide a minimum 0.003-inch gap between the retainers and bearings.

(d) The pin is approximately 1.50 inches in diameter and 6.7 inches long.

(e) Each end contains a conical shaped aluminum alloy plug which is bonded to the inside diameter. (Inside diameter of pin is tapered to a certain point.) Plug provides retainer bolt sizing.

(f) The lead-lag link hinge pin and bearing arrangement allows for free horizontal motion, allowing the M/R blade to move fore and aft (lead and lag).

(6) Bonding jumpers are attached to the lead-lag link via brackets (at the main rotor damper rod end bearing attachment points) and the bearing retainer attachment point.

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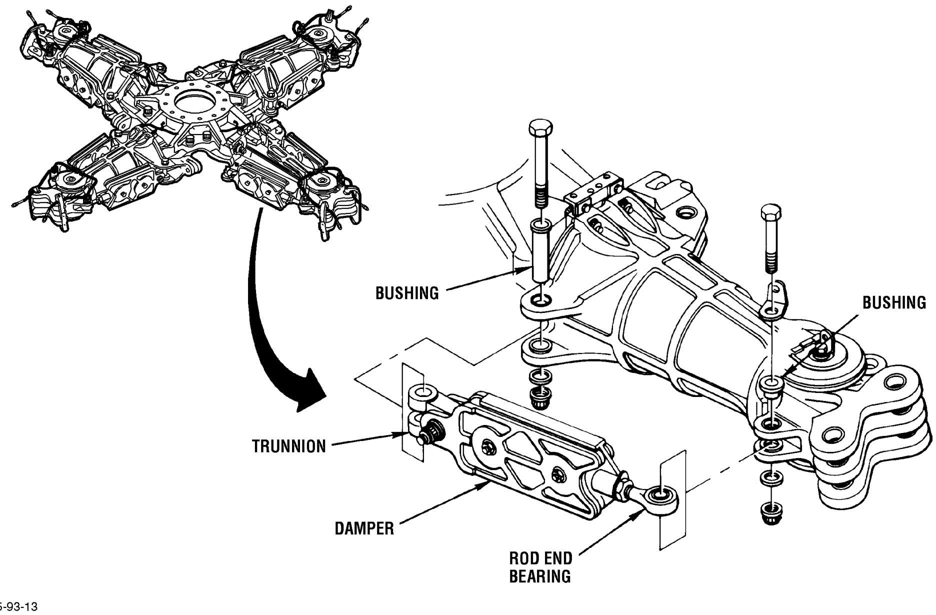
MAIN ROTOR DAMPER ASSEMBLY



NOTES

15. Main rotor damper assembly

a. Controls lead-lag movement of the main rotor blades and prevents mass unbalance (unequal blade spacing).

b. Mounted alongside (left and right) the pitch housing.

c. The trunnion portion is secured to the inboard clevis of the pitch housing by

(1) Bolt

(2) Bushing - corrosion resistant steel, approximately 3.4 inch in length. Extends through the upper lug and the trunnion. Sealing compound is used during installation.

(3) Washer and nut

d. The rod end portion is secured to the inboard lugs of the lead-lag link by

(1) Bolt

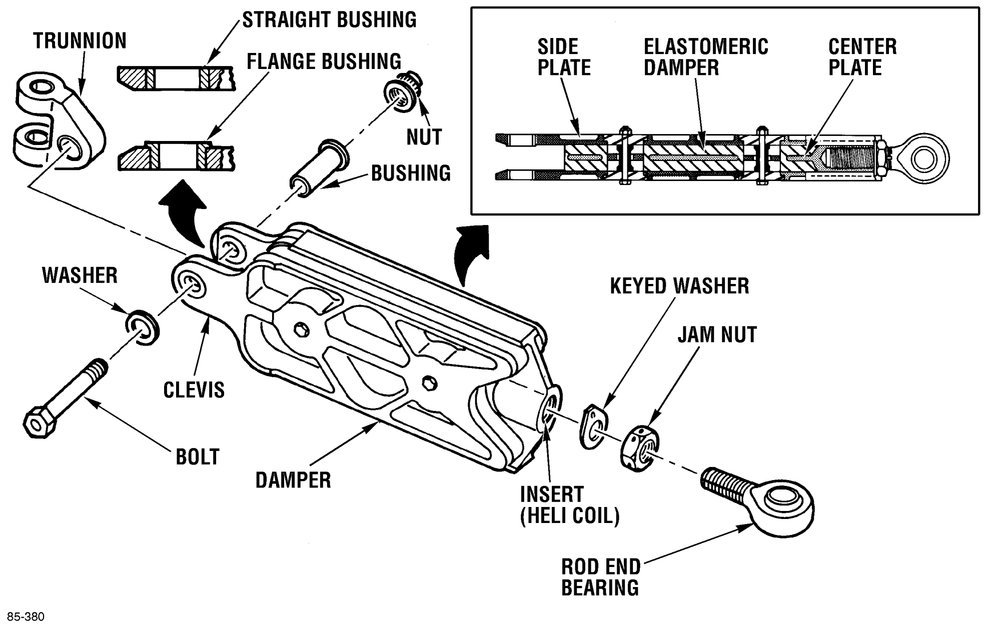
(2) Clip (already discussed)

(3) Bushing - corrosion resistant steel, approximately 0.715 inch in length. Extends through the upper lug on the lead-lag link.

(4) Washer and nut

C

MAIN ROTOR DAMPER ASSEMBLY-DESCRIPTION



NOTES

e. The damper assembly consist of

(1) Damper

(a) Constructed of a rubber compound bonded to a center metal plate and sandwiched and bonded to two outer plates. (Elastomeric construction.)

(b) The outboard end contains a threaded insert (heli-coil).

(2) Rod end bearing

(a) Material - corrosion resistant steel, teflon liner, silver plated bearing (0D).

(b) Secured to the damper by a keyed washer and jam nut.

(c) The rod end bearing is adjustable, and is used for blade phasing and balancing of the main rotor head assembly.

(3) Trunnion

(a) Material - aluminum alloy

(b) The bearing surfaces of the trunnion are coated with teflon.

(c) The trunnion is fixed and holds the damper in place.

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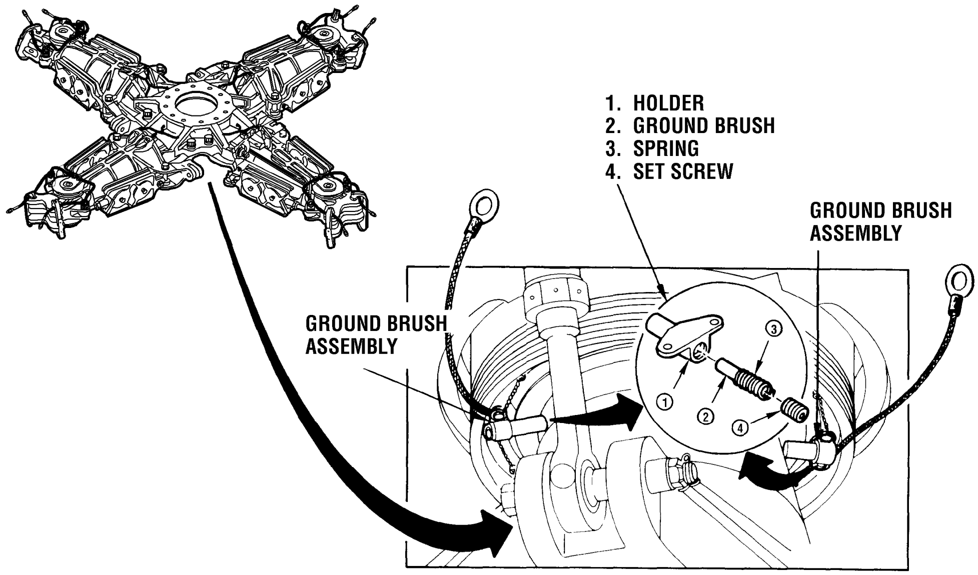
GROUND BRUSH ASSEMBLY



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NOTES

16. Ground brush assembly

   a. Transfers static electricity from the main rotor hub to the static mast.

   b. Prevents the static electricity build-up from causing erosion of the tapered roller bearings.

   c. Mounted on the lower seal retainer 180 degrees apart.

   d. Connected through bonding cables to the rotor head and blades for proper static bonding.

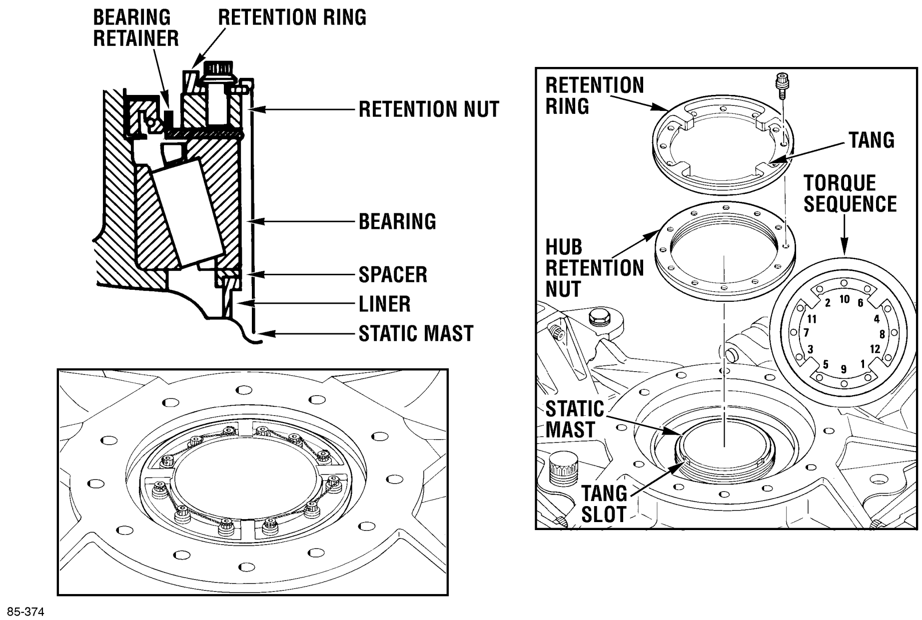
   e. Consists of the holder, ground brush, spring, and set screws.

      (1) Holder - corrosion-resistant steel and is threaded at one end to secure the ground brush and spring. Two holes drilled in the base portion provide its mounting and attachment for the static bonding cables.

      (2) Ground brush - the graphite brush is approximately 0.5 inch long and is bonded to the spring assembly.

C

MAIN ROTOR HUB NUT INSTALLATION



NOTES

E. Hub retention nut and hub nut retention ring

a. Attaches the main rotor head assembly to the static mast and pre-loads the upper and lower tapered roller bearings.

b. Mounted on the static mast into the M/R head.

c. The retainer is a machined corrosion resistant steel ring. Outside diameter is 8 inches with the inside being approximately 6.07 inches. Machined into the inside diameter are four tangs spaced 90 degrees apart. The tangs mate with the grooves in the static mast. Twelve holes are equally positioned around the retainer.

d. ECP 1187R1 replaces 12 existing nickel-plated machine bolts, with cadmium-plated machine bolts. Replace existing M/R Hub Retention Nut, P/N 7-311411103-3, with new configuration nut, P/N 7-311411102-5, which will change outside diameter of nut and the seal retainer plate. The ECP also changes the material of the nut to maraging 200 steel.

e. The hub nut is made of maraging 200 steel. Outside diameter is approximately 8.12 inches, inside diameter being approximately 6 inches and 0.650 inch thick. Twelve holes are equally positioned around the nut. The nut uses left-hand threads, which is indicated on the outside diameter (LH THD).

f. Pre-loading is accomplished by use of a special torquing procedure.

g. Pressure from the retaining bolts presses down on the upper seal retainer which transfers the force to the bearings inner race.

h. The retention nut has left-hand threads. (Rotate counterclockwise to install.)

i. The retention ring fits over the hub retention nut.

j. The (12) twelve bolt holes are only clearance holes.

k. The (4) four tangs provide the locking feature to the static mast.

l. Torque sequence is identified by numbers adjacent to the bolt holes.

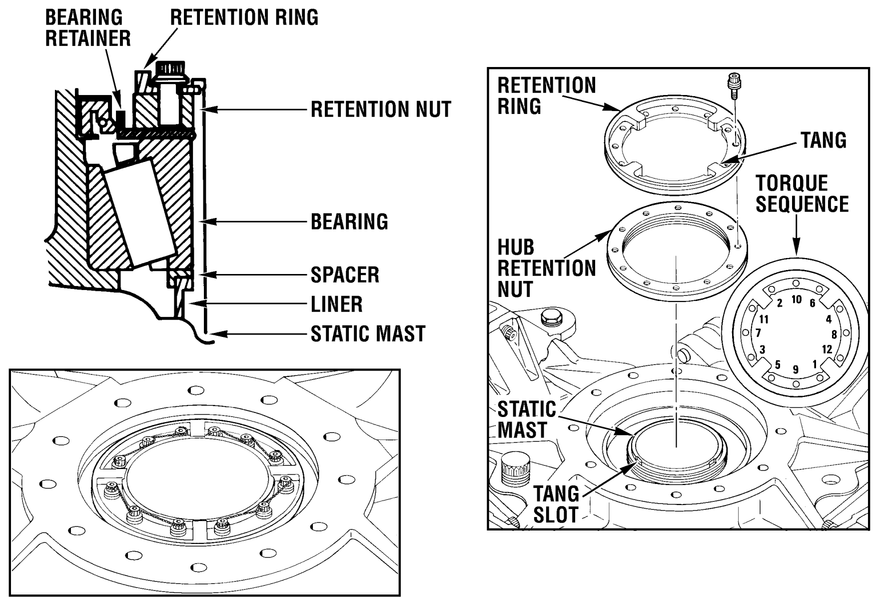
m. Install hub retention nut and hand tighten against the flanged seal retainer.

n. Align tangs of retention ring with slots on static mast and place retention ring on top of hub retention nut.

o. If required, back off hub retention nut to the first position where its holes line up with those in the retention ring.

C

MAIN ROTOR HUB NUT INSTALLATION



85-374

NOTES

p. Install the (12) twelve bolts.

q. Torquing the (12) twelve bolts that go through the retention ring and hub retention nut presses down on the upper seal retainer which transfers the force to

(1) Bearing inner races

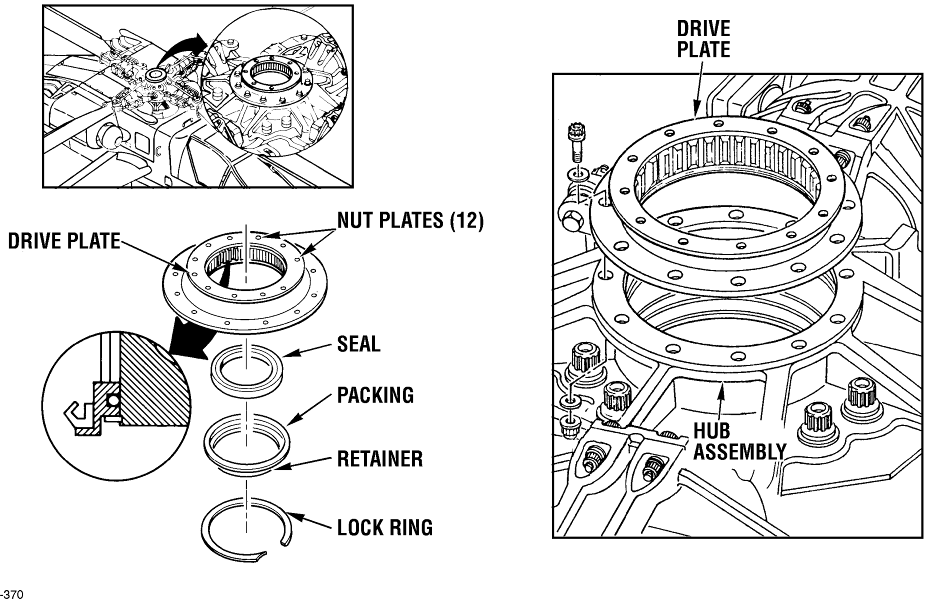
(2) Bearing pre-load spacer (predetermined)

(3) Inner liner

(4) Static mast

C

MAIN ROTOR DRIVE PLATE INSTALLATION



NOTES

1. Drive plate

   a. Transfers rotating motion from the main rotor drive shaft to drive the main rotor head assembly.

   b. Mounted on top of the main rotor hub and splined directly to the main rotor drive shaft.

   c. Description

      (1) Material - steel

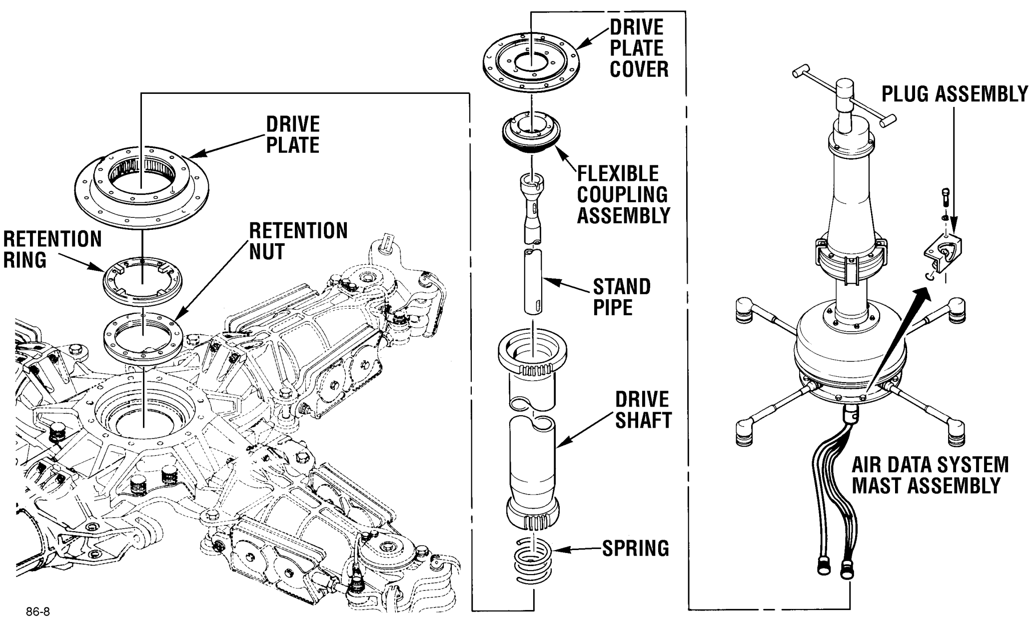
      (2) The inner diameter (approximately 7.2 inches) is splined to provide interface with the main drive shaft.

      (3) The lower mating surface outside diameter is approximately 13.4 inches and contains twelve evenly spaced holes for securing the plate to the hub.

      (4) The upper surface outside diameter is approximately 9.8 inches and contains twelve evenly spaced holes with nut-plates on the under surface. Provides a means for securing the drive plate cover and air data system mast.

C

REMOVAL/INSTALLATION RELATED MAJOR COMPONENTS (2)



NOTES

2. Main rotor drive shaft

   a. Transmits power from the main transmission to drive the main rotor head.

   b. The main rotor drive shaft is mounted inside the static mast between the main transmission splined output carrier hub and the splined drive plate of the main rotor head.

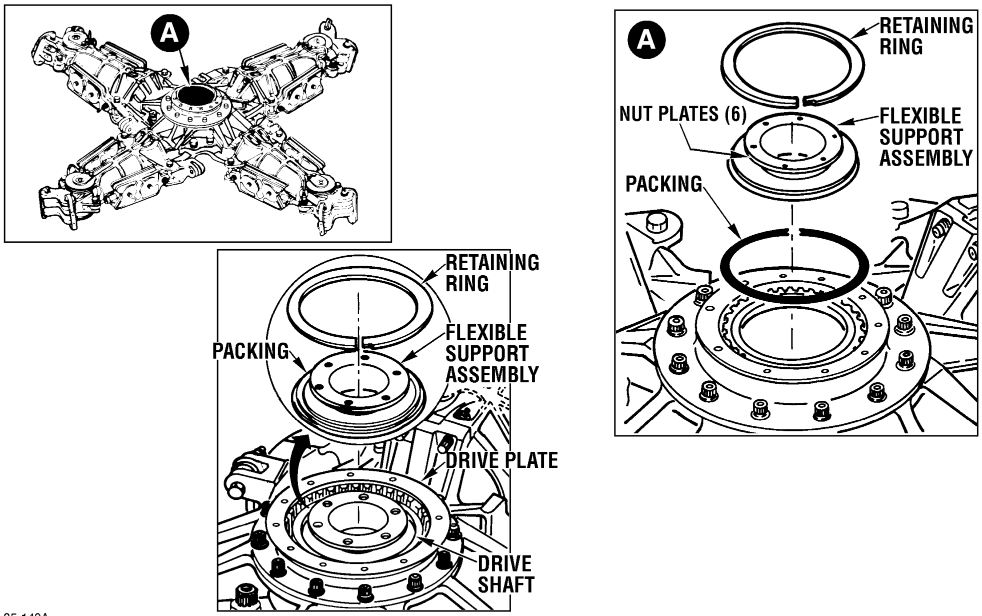
   c. The inside diameter of the lower coupling is machined to accept the drive shaft spring.

      (1) The spring supports 150 pounds + 10.0 pounds when compressed to 1.30 inches in length.

      (2) Supports the drive shaft and the carrier hub of the main transmission.

C

FLEXIBLE SUPPORT ASSEMBLY INSTALLATION



85-140A

NOTES

3. Flexible support assembly

   a. Allows the main rotor drive shaft to float inside the static mast.

   b. Installed inside the upper end of the main rotor drive shaft and bolted to the main rotor drive plate cover.

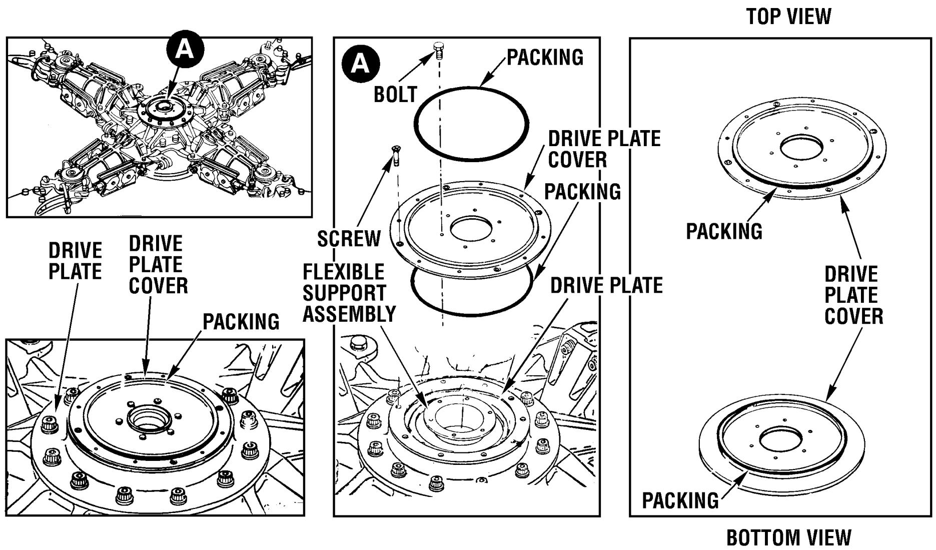
   c. Constructed of a rubber inner core bonded to a metal center and outer frame.

   d. Compresses the main rotor drive shaft which in turn compresses the drive shaft spring.

   e. Secured to the main rotor drive shaft by a lock ring.

C

MAIN ROTOR DRIVE PLATE COVER INSTALLATION



85-364

NOTES

4. Drive plate cover

   a. Provides a mounting pad for the air data system mast and the attachment for the flexible support assembly.

   b. Installed on the drive plate

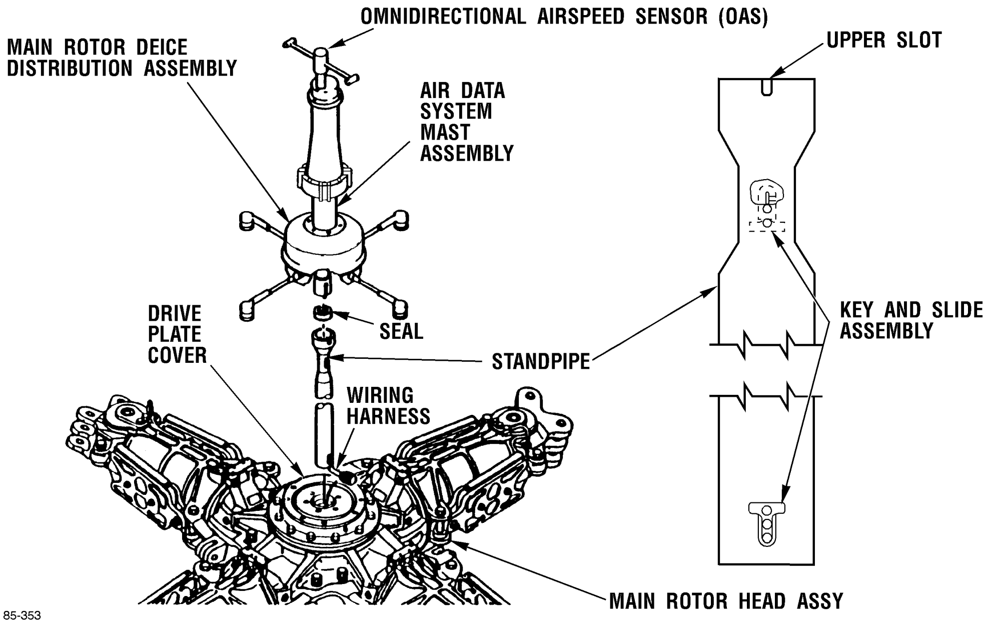
   c. Material - 4340 steel

   d. A groove is machined into the upper and lower surfaces for installing preformed packings.

   e. An access hole is provided for the air data system mast standpipe and electrical wiring.

C

AIR DATA SYSTEM MAST ASSEMBLY INSTALLATION



NOTES

5. Air data mast assembly

   a. Houses the omnidirectional airspeed sensor (OAS) and the main rotor deice system distribution assembly.

   b. Mounted to the drive plate via the drive plate cover.

   c. The main rotor deice distribution assembly rotates with the M/R head.

   d. The ADS mast and OAS remain stationary. However, the OAS is driven (720 RPM) electrically when the ADS switch is energized.

   e. An aluminum alloy standpipe assembly extends through the main rotor drive shaft to protect the electrical wire harness for the deice and air data system.

      (1) The standpipe is approximately 58.7 inches long and mates to a transmission standpipe assembly and the ADS mast assembly.

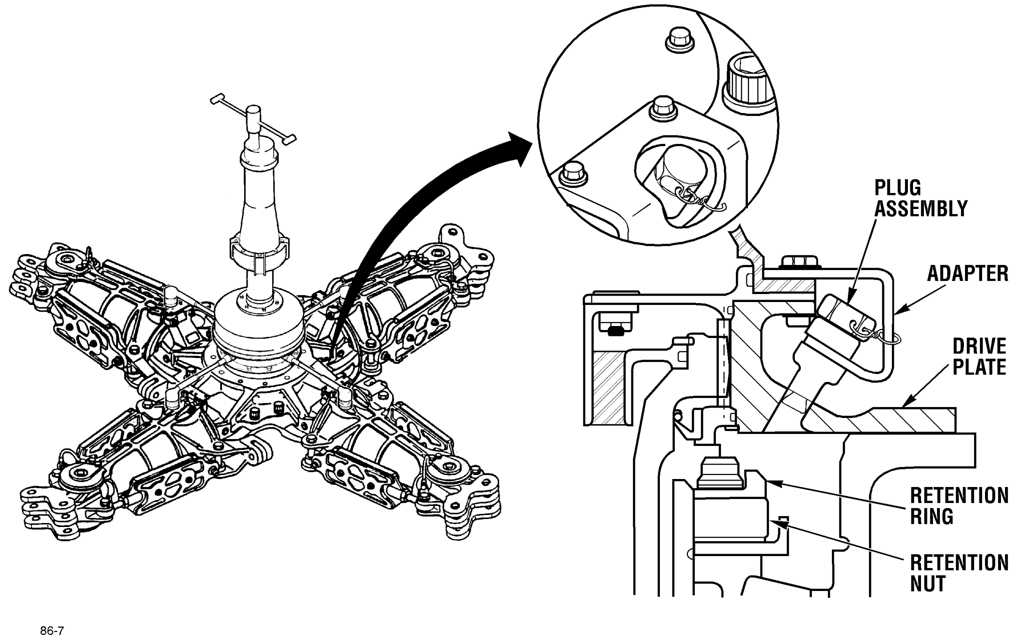
      (2) An aluminum alloy key and a graphite/teflon slide assembly are bonded, then riveted to both ends of the standpipe. The upper key/slide assembly is installed to the inside diameter while the lower is installed to the outside diameter. These assemblies secure the standpipe.

      (3) A slot at the upper end provides an additional securing feature.

      (4) A sponge rubber seal is installed into the upper portion of the standpipe.

C

MAIN ROTOR BEARING NUT PLUG ASSEMBLY



NOTES

6. Main rotor bearing nut plug

   a. Used to check hub retention nut installation.

   b. Mounted to the drive plate, and secured to the air data system mast assembly by a bracket.

   c. Consists of

      (1) An aluminum alloy flange (bracket) assembly that secures the plug assembly.

      (2) An aluminum alloy adapter assembly which is installed through the drive plate and provides the means for viewing the hub nut. An O-ring is installed at the lower portion.

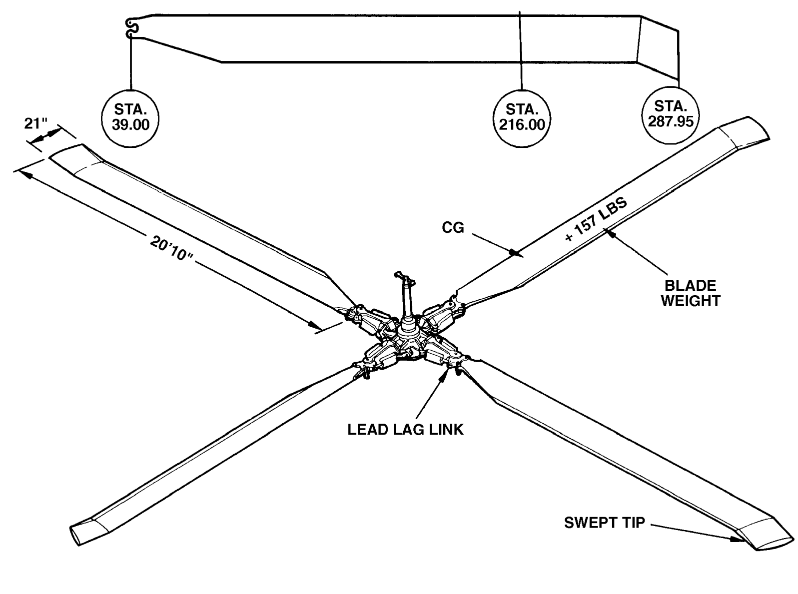
   d. A plug is installed into the adapter to seal the assembly when not being used. Once the plug is tightened it is safety wired to the flange.

   e. A plug is removed to visually check the hub retention nut installation.

   f. The early configuration of the drive plate had a hub nut plunger. Due to an increased height of the production hub nut retainer, interference could exist between the plunger and the hub nut which could give a false indication of hub nut installation. To correct this problem, the hub nut plunger was changed to a plug assembly that allowed visual assurance of proper hub nut installation (ECP 512). ECP 1107 eliminates the plug assembly and the hole in the drive plate where the plug assembly was installed. Moisture entering into this hole was causing corrosion.

C

MAIN ROTOR BLADE ASSEMBLY DIMENSIONS



NOTES

F. Main rotor blade assembly (4)

1. A rotating airfoil that provides the lift and directional flight capability for the helicopter.

2. Installed on the main rotor head lead-lag link

3. Length - 20 feet, 10 inches

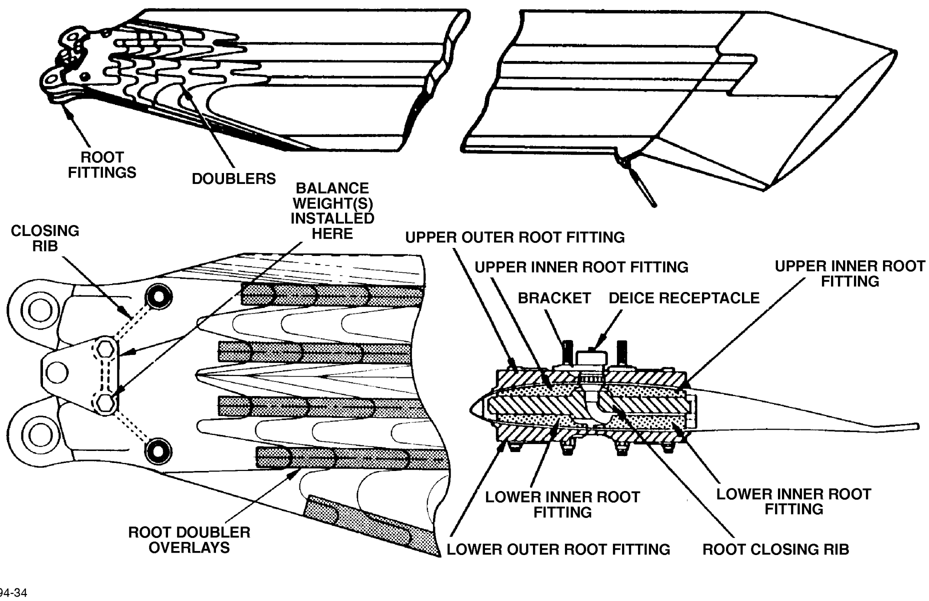
4. Width - 21 inches

5. Weight - 157 pounds, stenciled to the right of the blade "C.G." marker

6. A swept tip aids in better lift capability and reduces noise.

C

MAIN ROTOR BLADE ASSEMBLY (1)



NOTES

7. Blade root section consists of

   a. Six titanium alloy root fittings

      (1) Lower outer root fitting

      (2) Lower inner root fitting (2)

      (3) Upper outer root fitting

      (4) Upper inner root fitting (2)

   b. Aluminum alloy closing rib

   c. Five upper and lower stainless steel doublers

   d. The root fittings, closing rib, doublers, and skin are all adhesively bonded together and secured by four bolts, nuts, and washers.

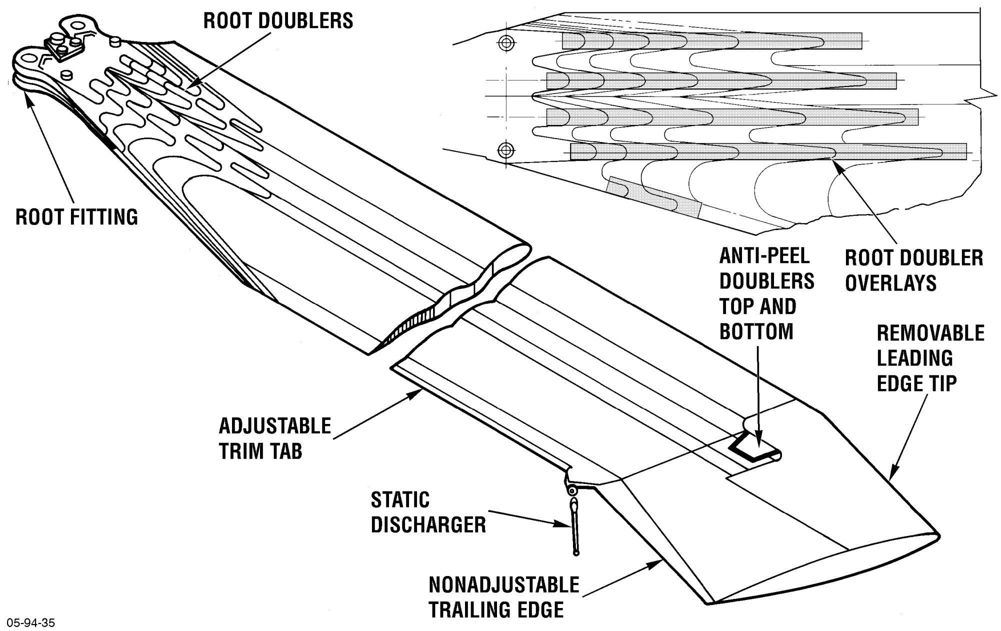
      (1) The two bolts at the upper inboard surface of the root section provide mounting for the deice receptacle bracket.

      (2) The bolts also allow for installing balance weights to smooth the rotor system.

   e. The extreme inboard portion of the root fitting consists of four mounting lugs to secure the blade to the lead-lag link.

C

MAIN ROTOR BLADE ASSEMBLY (2)

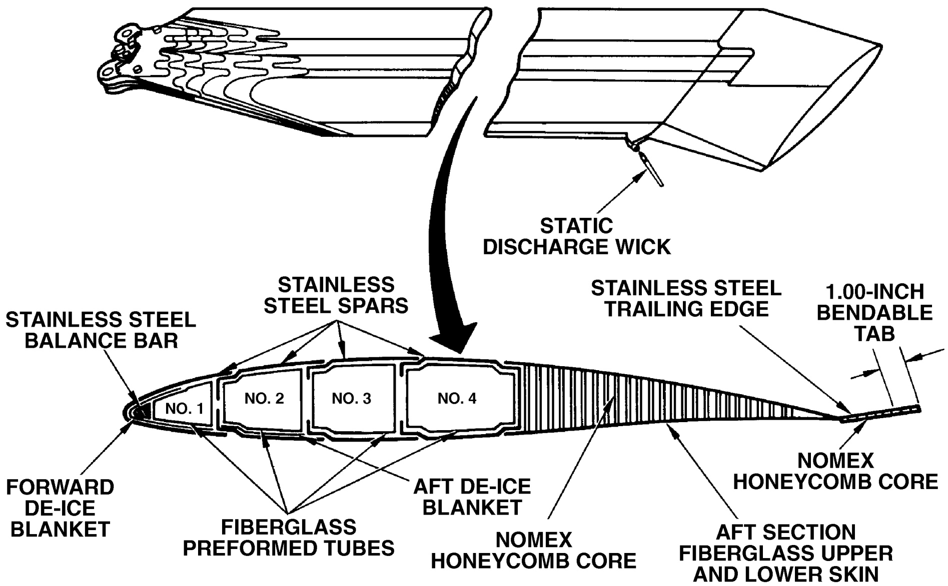


NOTES

8. ECP 1098 directed the application of a lower surface no. 2 tip spar anti-peel doubler and root doubler overlays. This was prompted by receipt of several reports which indicated peeling of the stainless steel root doublers and de-lamination of the no. 2 spar tip lower surface. The application of an additional anti-peel doubler to the no. 2 spar tip lower surface and root doubler overlays prevents de-lamination.

C

MAIN ROTOR BLADE SECTIONAL VIEW



NOTES

9. Main rotor blade construction

   a. A stainless steel leading edge balance bar extends from station 46.16 to station 270.44.

   b. Three tungsten leading edge core balance weights are pinned to the leading edge balance bar. Each weight is 7.2 inches long.

   c. The blade forward section is a four cell unit of stainless steel and fiberglass.

      (1) The single piece number 1 spar forms the leading edge.

      (2) Number 2 and number 3 spares are two piece spars (top and bottom).

      (3) Number 4 spar is formed by a single piece of stainless steel.

   d. A stainless steel balance bar runs the entire length of the blade.

   e. The forward deice blanket runs the length of the blade and is integral with number 1 spar.

   f. The lower deice blanket runs the length of the blade and is integral with the lower part of the number 2 spar.

   g. Four fiberglass preformed tubes are bonded to the inner skin of the spars to retard crack propagation.

   h. The blade aft section consists of upper and lower fiberglass (laminated unidirectional) skin (0.029) bonded to a Nomex honeycomb core, and bonded to the blade forward section.

   i. The trailing edge consists of one-piece stainless steel skin bonded to a nomex honeycomb core. The trailing edge is bonded to the blade aft section.

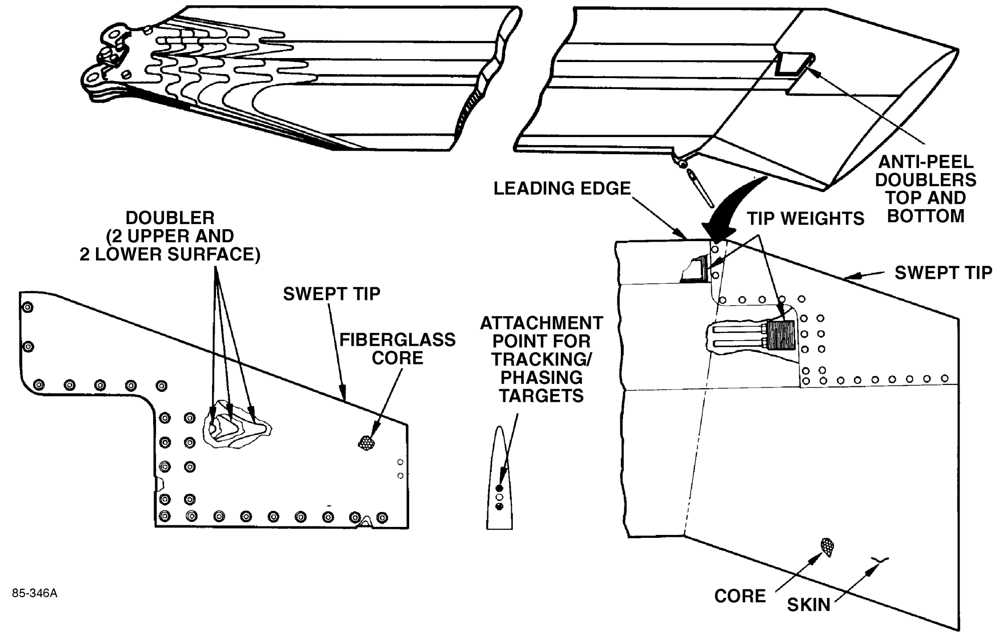
   j. The adjustable trim tab can be moved to correct for in-flight tracking discrepancies.

   k. The static discharger expels static electricity caused by air friction.

   l. Blades are interchangeable.

C

MAIN ROTOR BLADE SWEPT TIP



NOTES

10. The swept tip consists of

    a. Removable leading edge tip

    b. Secured by several special screws along the upper and lower surface

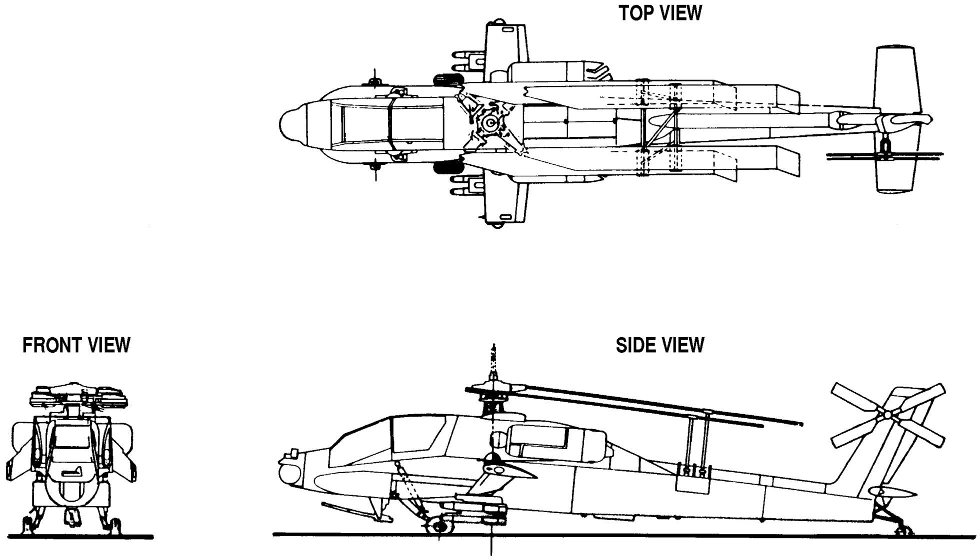
    c. Consists of six upper and lower stainless steel doublers and a fiberglass fabric core.

    d. Two sets of tip weights are installed into the swept tip and secured by two studs, nuts, washers (each). They are accessible by removing the leading edge tip.

    e. The swept tip aft section consists of upper and lower fiberglass skin bonded to a nomex honeycomb core.

C

MAIN ROTOR BLADES FOLDED



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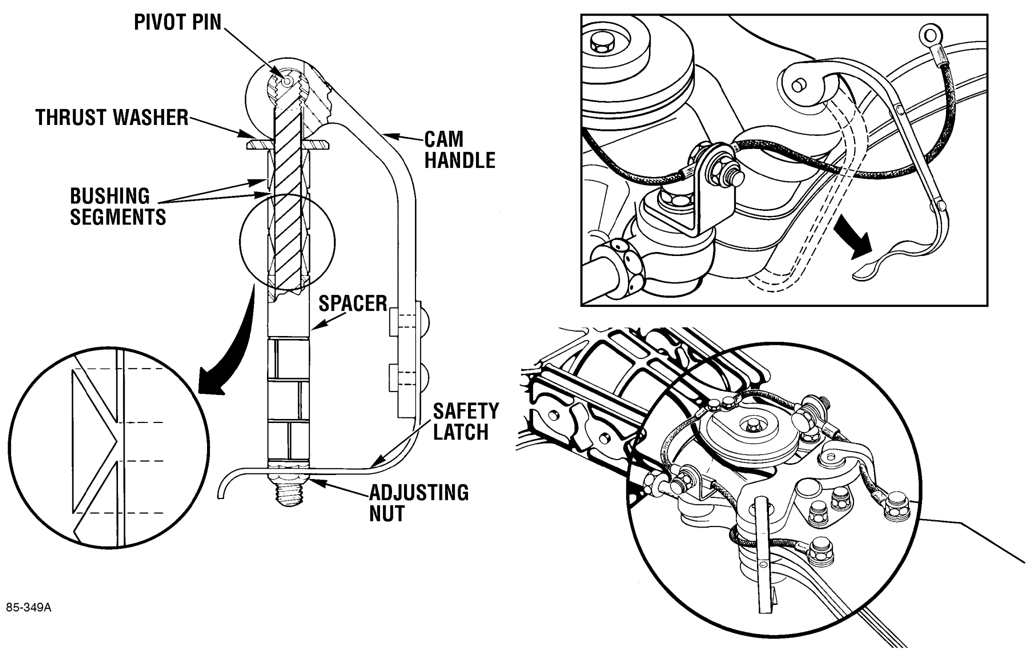
NOTES

11. The blades can be manually folded.

C

BLADE ATTACHMENT PIN



NOTES

12. Blade attach pin

a. Attaches and secures the main rotor blade to the lead-lag link of the main rotor head.

b. Installed in the main rotor blade retention fitting and the lead-lag link.

c. The steel pins are an adjustable bushing type incorporating several split bushing segments, spacers, a thrust washer, an eccentric cam, and an aluminum cam handle with an expandable steel safety latch.

d. To install the bolt, the cam handle is rotated upward until the low side of the cam is against the thrust washer. This allows the split bushing segments to contract and the bolt can easily be inserted into the blade fitting holes.

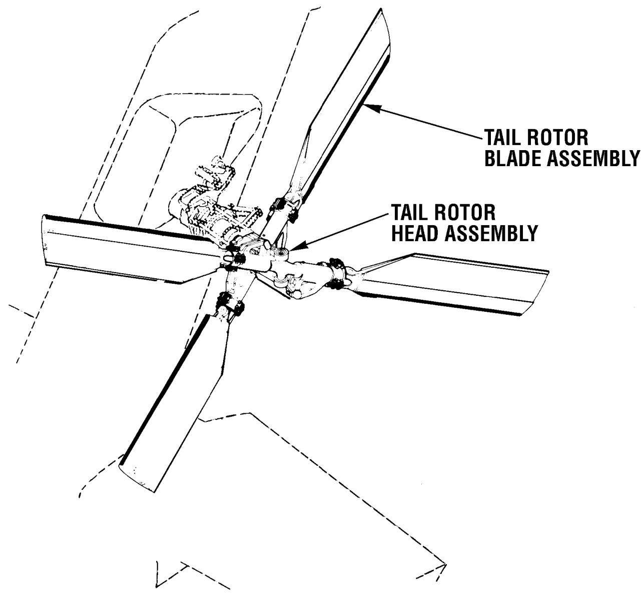
e. With the bolt fully inserted into the blade fitting holes, the cam handle is rotated downward until the safety latch can be fitted over the shank of the bolt. This causes the high side of the cam to ride against the thrust washer and the split bushing segments to expand for a tight fit in the blade fitting holes.

f. A dial indicating gage (push pull) is used to check the cam handle for the proper closing, allowing for setting proper handle closing force.

g. ECP 932R2 added ground brush bonding jumpers to the main rotor head. Ensure that the main rotor blade bonding cables are placed inside the cam handles before they are latched.

C

TAIL ROTOR ASSEMBLY



NOTES

A. Tail rotor assembly

1. Provides anti-torque and directional flight heading capability for the helicopter by using the pilot/CPG foot pedals.

2. Installed on the tail rotor gearbox output shaft.

3. ECP 1044 replaces the original aluminum tail rotor non-rotating swashplate with a one-piece steel non-rotating swashplate. The new swashplate uses a new bearing and grease dam for improved lubrication and increased fatigue life.

4. Uses a single four blade teetering tail rotor head assembly

   a. 9.166 foot diameter

   b. Clockwise rotation

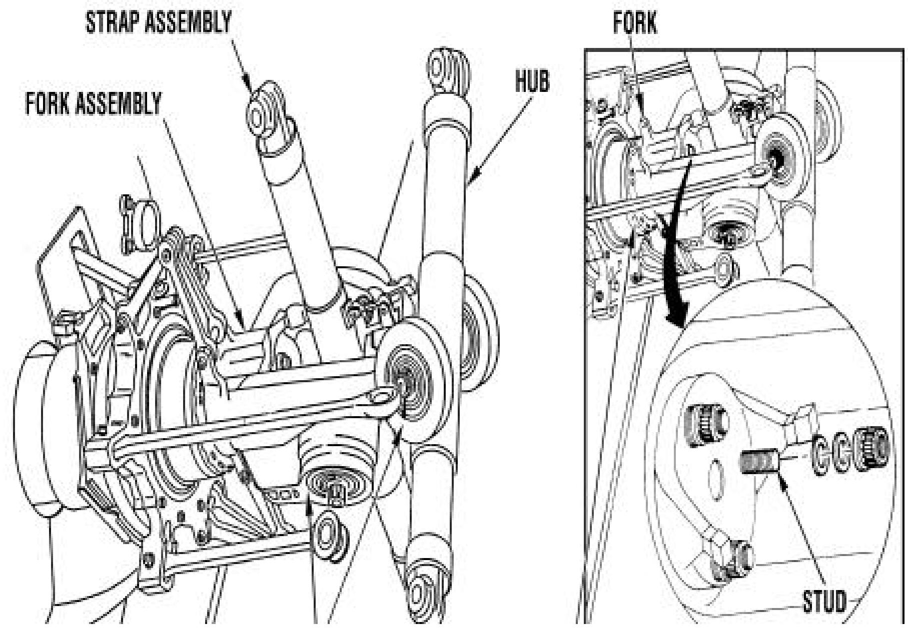
   c. Blades 55E apart

5. Major components

   a. Tail rotor head assembly

   b. Tail rotor blade assembly

TAIL ROTOR HEAD-DESCRIPTION



NOTES

B. Tail rotor head assembly characteristics

1. Provides attaching points for the tail rotor blades and the means to drive the blades.

2. Mounted to the curvic coupling and secured by three stud/nut combinations.

3. Weight - 39.1 pounds

4. Major components

    a. Fork assembly

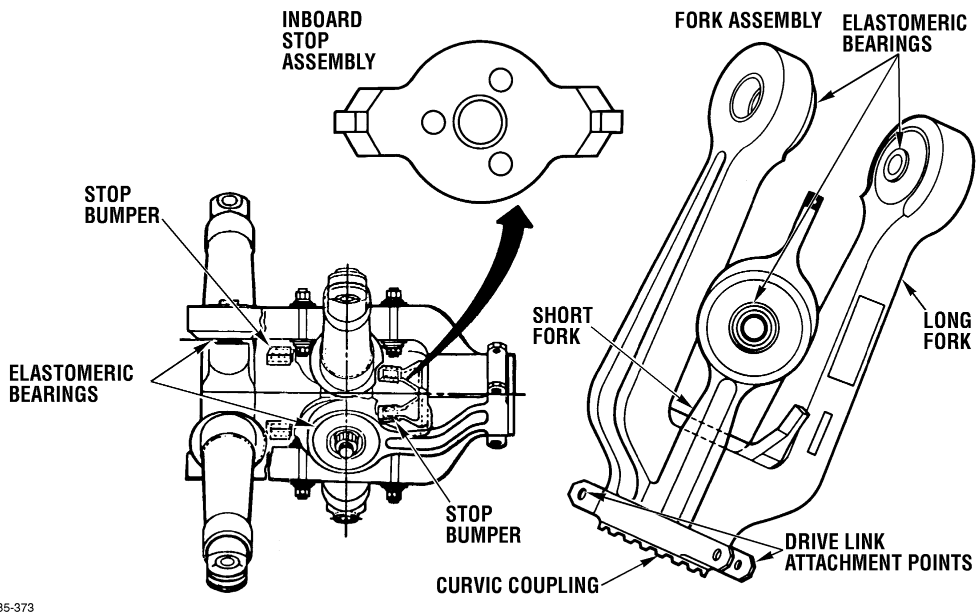
    b. Elastomeric bearings (4)

    c. Tail rotor hubs (2)

    d. Strap assemblies (2)

C

TAIL ROTOR HEAD ASSEMBLY



NOTES

C. Tail rotor head assembly component description

1. Fork assembly

a. Provides mounting points for the tail rotor hubs.

b. Mounted to the output shaft of the tail rotor gearbox.

c. Made of titanium steel.

d. Consist of a short and long fork set 55 degrees apart.

e. The inboard section of the assembly consists of

(1) Two integral clevises 180 degrees apart, which provide attachment for the drive links.

(2) A curvic coupling to provide positive interface with the tail rotor gearbox output shaft.

f. The fork assembly contains two teetering stops. The teetering stops are integral with forks and restrict the teetering action of the hubs.

(1) The outboard stop is integral with the fork and has a polyurethane bumper bonded to each end of the stop.

(2) The inboard stop assembly is bonded to the fork and contains a polyurethane bumper bonded to each end of the stop. The stop is titanium.

g. The fork assembly consists of two integral forks, a long and short.

(1) Secured to the sides of the long fork is an aluminum plate clamp which provides a mean for securing the deice harness.

(2) Drives the rotating swashplate via the drive links.

2. Elastomeric bearings (4)

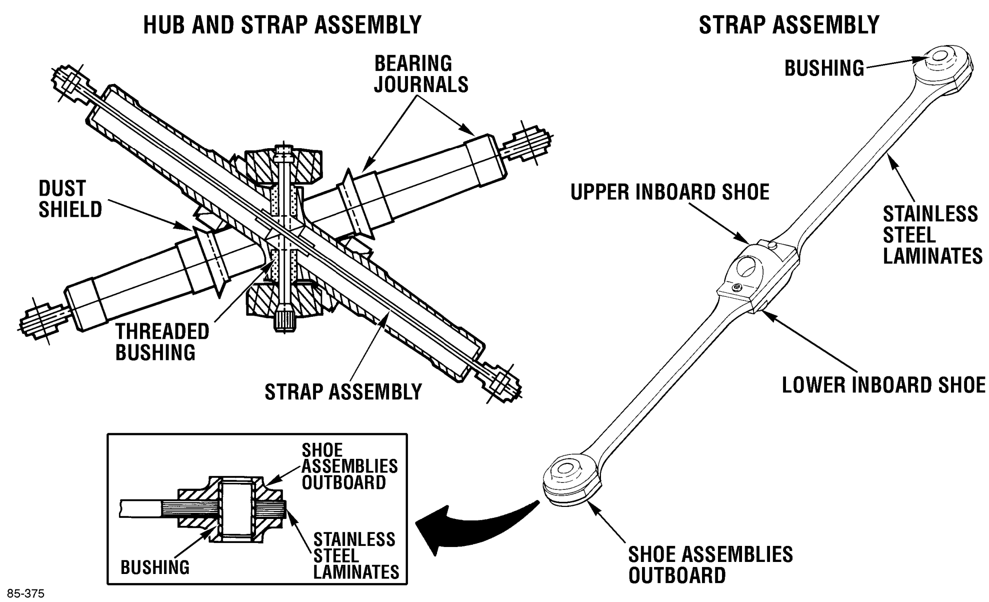
a. Allows the hubs to teeter (see-saw) on the forks.

b. Bonded to the outboard end of the forks.

c. Constructed of a series of thin metal conical shaped sleeves separated by rubber.

C

TAIL ROTOR HUB AND STRAP ASSEMBLY



NOTES

3. Tail rotor hub

   a. Provides the mounting point for the tail rotor blade.

   b. Installed on the fork assembly.

   c. Made of titanium steel.

   d. Has a delta hinge attachment.

   e. Threaded stainless steel bushings (2) provide mounting security.

   f. Shims are installed between the bushing and folk assembly to properly center the hub.

   g. Four bearing journals (2 each side) mate with the pitch change bearings in the root end of the tail rotor blades.

   h. A rubber dust shield is mounted at the hub base.

4. Strap assemblies (2)

   a. Transmit centrifugal loads from the tail rotor blades to the head assembly and provides feathering motion of the blades.

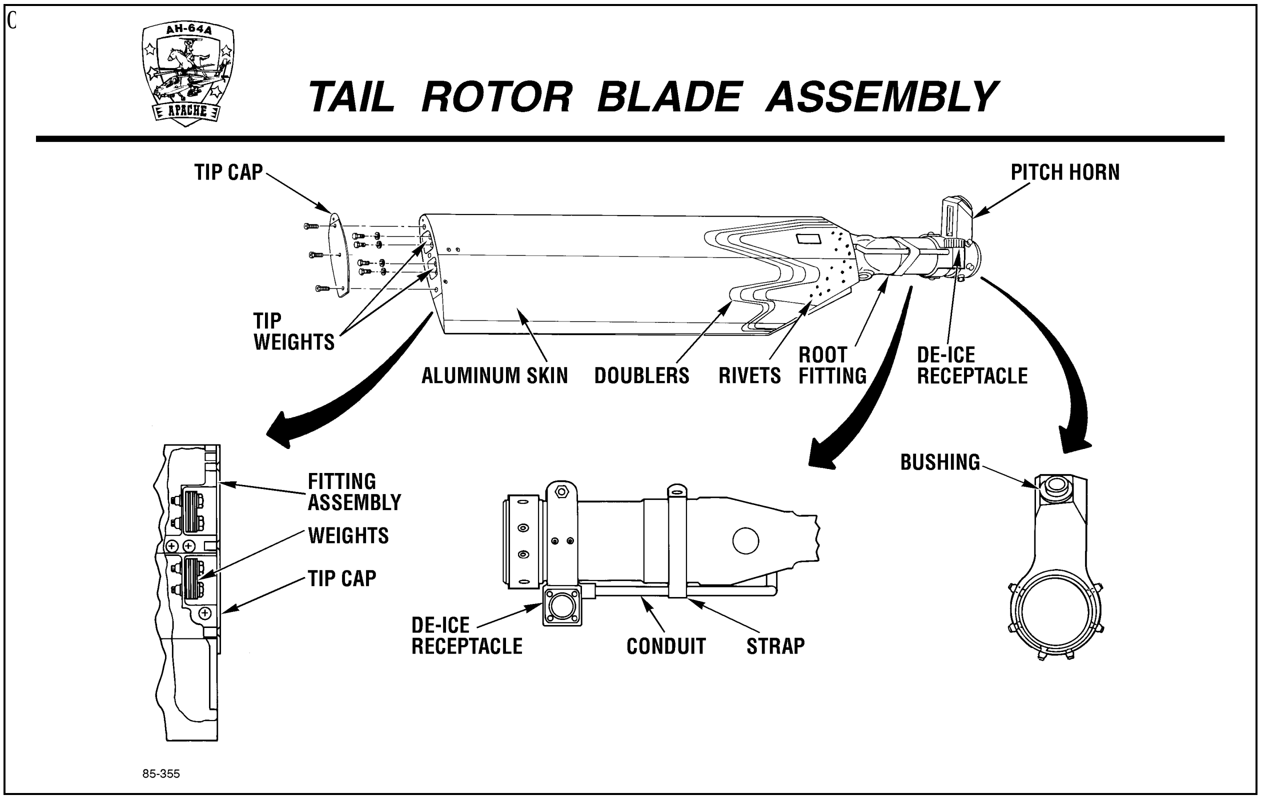
   b. Provide attachment for the tail rotor blades to the hubs.

   c. The strap assembly passes through the hub and is mounted to the center of the hub with threaded bushings.

   d. The stainless steel laminate strap set consists of 21 or 22 laminates approximately 24.8 inches in length and 0.014 inch thick.

   e. Will twist allowing the blade to change pitch angle.

   f. Transfers centrifugal forces from the blades to the fork assembly.


C
TAIL ROTOR BLADE ASSEMBLY
TIP CAP
PITCH HORN
TIP
WEIGHTS
ALUMINUM SKIN
DOUBLERS
RIVETS
ROOT
FITTING
DE-ICE
RECEPTACLE
BUSHING
FITTING
ASSEMBLY
WEIGHTS
TIP CAP
DE-ICE
RECEPTACLE
CONDUIT
STRAP
85-355

NOTES

D. Tail rotor blade assemblies (4)

1. Provides the thrust to maintain the desired direction of flight.

2. Mounted over the hub and secured to the strap assembly by a PLI washer, bolt and nut combination.

3. Length - 51.42 inches

4. Cord - 10 inches

5. Blade consists of

a. Pitch horn

(1) An ESR steel pitch horn is riveted to the root fitting and provides attachment for the pitch change links, the deice blanket electrical receptacle, and the static bonding cable.

(2) The pitch horn contains a steel bushing for attaching the pitch link.

b. Root fitting and doublers - An aluminum alloy root fitting together with four upper and four lower aluminum alloy doublers are joined to the spars by adhesive bonding and metal fasteners (rivets).

c. Bearings - Two self-lubricating teflon bearings are bonded to the inside diameter of the root fitting. The bearings provide blade rotational movement around the hub.

d. Deice receptacle - A deice receptacle is attached to the outboard end of the root fitting.

e. Conduit - An aluminum alloy conduit extends from the receptacle along side the root fitting into the blade. A strap attached to the inboard end of the root fitting provides a means of securing the conduit.

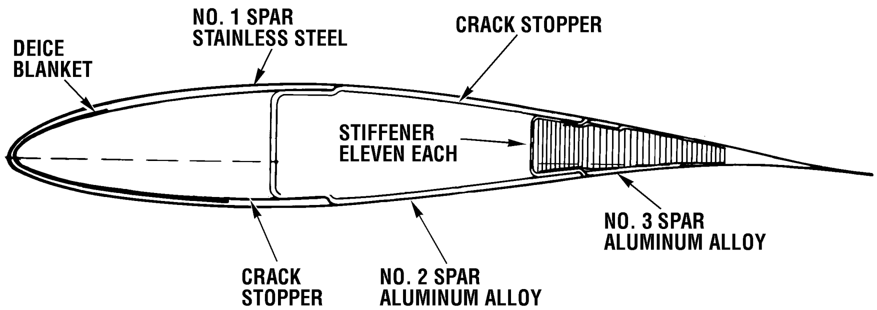
f. The inboard section of the root fitting provides the blade attachment point.

g. Spanwise balance weights are located beneath the tip cap.

h. The blades rotate around the hub on self-lubricating teflon bearings.

C

TAIL ROTOR BLADE CONSTRUCTION



85-369

NOTES

E. Tail rotor blade construction

1. The number 1 spar makes up the leading edge; it is made of stainless steel. A deice heater blanket is bonded to the spar and unidirectional fiberglass is used to prevent crack propagation.

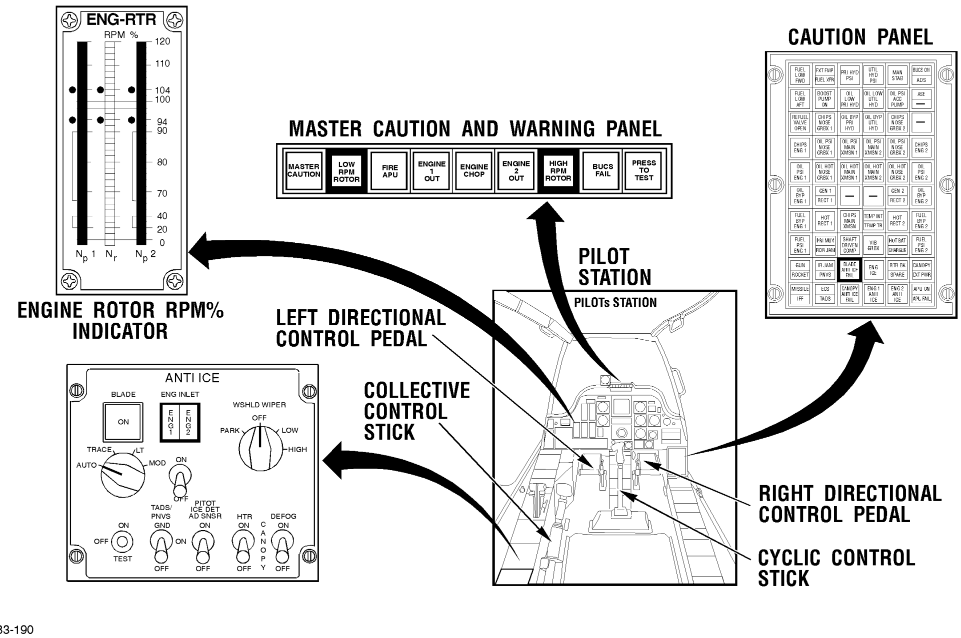
2. The number 2 spar is constructed of aluminum alloy and the inside portion contains unidirectional fiberglass.

3. The number 3 spar makes up the trailing edge and is constructed of aluminum alloy. Eleven aluminum honeycomb stiffeners are bonded into the spar to add strength to the blade. They are spaced equally spanwise at 3.25 inch intervals.

4. Each spar is lined with unidirectional bonded fiberglass to retard crack propagation.

C

CONTROLS AND INDICATORS



NOTES

A. Rotor system controls and indicators

1. Provide vertical and directional flight control of the aircraft.

2. Provide visual references of main rotor speed.

3. Provide deice control of main and tail rotor blades.

4. Major components

a. Collective control stick

b. Cyclic control stick

c. Directional control pedals

d. Engine-rotor (ENG-RTR) RPM % indicator

e. LOW RPM ROTOR warning light

f. HIGH RPM ROTOR warning light

g. BLADE ANTI-ICE FAIL warning light

h. ANTI-ICE panel

B. Rotor system control and indicator characteristics

1. Collective control sticks (2)

a. Controls the pitch angle on all main rotor blades (simultaneously).

b. Installed on the left side in each crewstation.

c. Collective control stick description is explained in the flight control lesson.

2. Cyclic control sticks (2)

a. Changes the tip path plane of the main rotor blades to produce directional flight.

b. Installed in the center of the pilot and CPG crewstation floors.

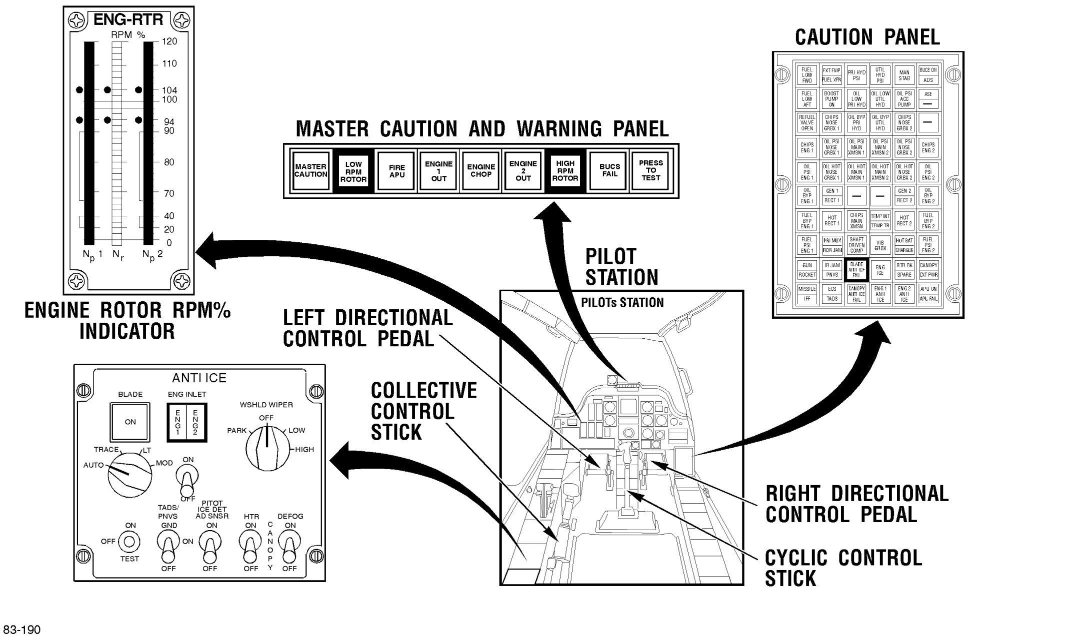
c. Cyclic control stick description is explained in the flight control lesson.

3. Directional control pedals (2)

a. Provides directional and anti-torque control of the helicopter.

C

CONTROLS AND INDICATORS



NOTES

b. Installed in the forward floor area in each crewstation.

c. Directional control pedals description is explained in the flight control lesson.

4. Engine-rotor (ENG-RTR) RPM % indicator

a. Provides the pilot and CPG with a visual reference of main rotor speed (N_R) in percent.

b. Installed on the center section of the pilot and CPG instrument panels.

c. The magnetic pickup transmits impulses created by a gear movement in the transmission. The indicator displays rotor speed in percent (100% = 289 RPM).

5. LOW RPM ROTOR warning light

a. Warns the pilot and CPG whenever the speed of the main rotor decreases below 94% (272 RPM).

b. Mounted on the pilot and CPG master caution and warning panels.

c. The crew will also receive an aural tone through their headsets.

6. HIGH RPM ROTOR warning light

a. Warns the pilot and CPG whenever the main rotor speed exceeds 104% (301 RPM).

b. Mounted on the pilot and CPG master caution and warning panels.

7. BLADE ANTI-ICE FAIL warning light

a. Will alert the pilot to a blade de-ice system failure.

b. Mounted on the pilot's caution/warning/advisory panel.

c. The malfunction can be traced and the fault isolated by using the on-board FD/LS.

8. ANTI-ICE panel

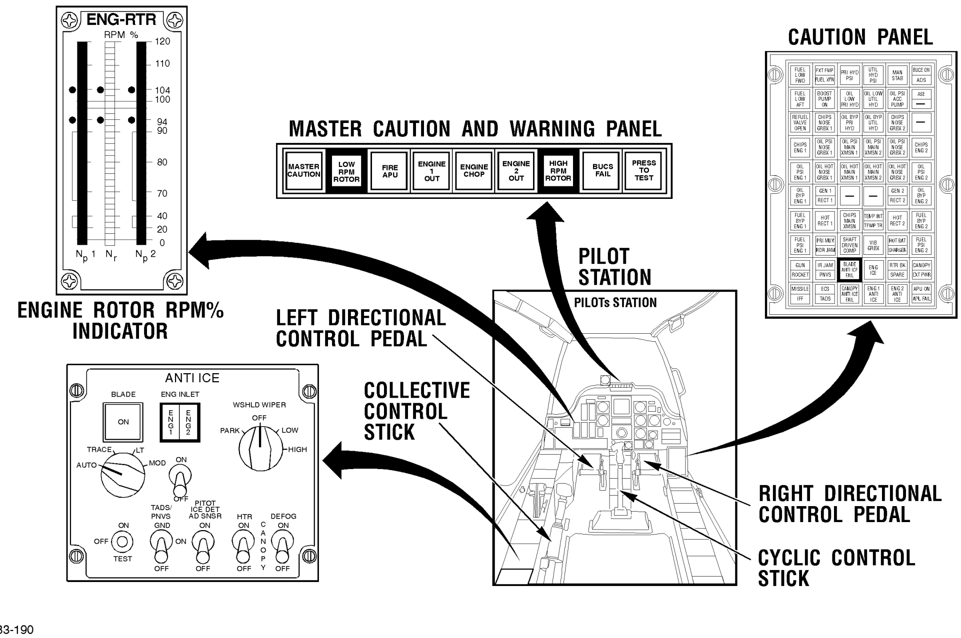
a. Contains the blade de-ice controls.

b. Installed on the left pilot console.

c. The blade deice ON advisory light will illuminate when the rotor blade deice system is operating.

C

CONTROLS AND INDICATORS



NOTES

d. The rotor blade deice control switch allows the pilot to turn the blade deice system ON, OFF or to TEST the system.

e. The ice detector manual override switch is a four position rotary switch.

(1) AUTO - Permits automatic blade deicing.

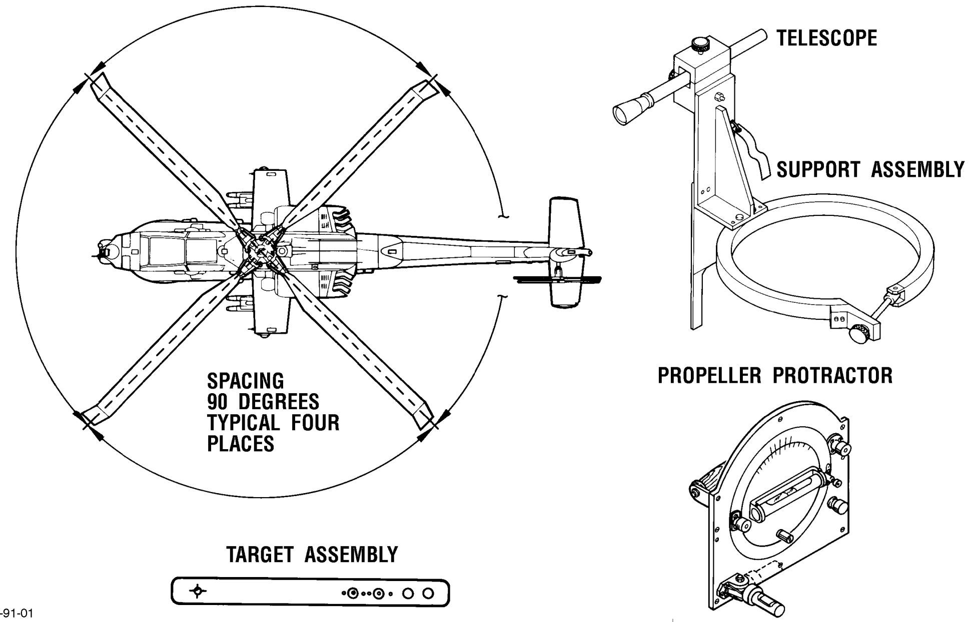
(2) TRACE - A manual mode for trace icing conditions.

(3) LT - A manual mode for light icing conditions.

(4) MOD - A manual mode for moderate icing conditions.

C

AH-64A MAIN ROTOR BLADE PHASING (1)



05-91-01

NOTES

A. Main rotor blade phasing kit

1. Blade phasing is required to align the four main rotor blade assemblies to each other.

2. Components

   a. Target assembly

   b. Support assembly

   c. Telescope

   d. Propeller protractor

3. Installation procedures

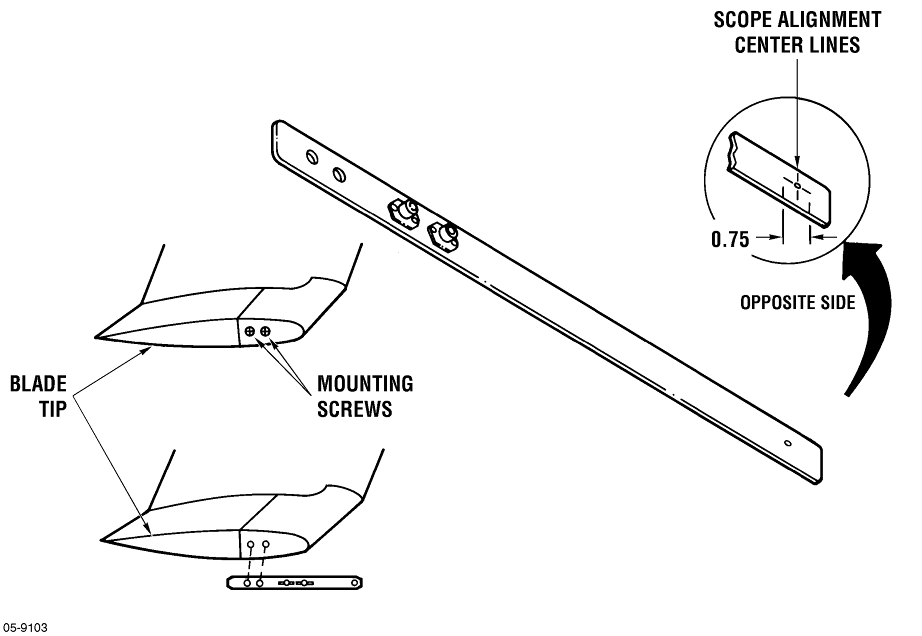
   a. Preliminary steps

      (1) Connect and apply auxiliary ground power unit (AGPU) electrical power and hydraulic power.

      (2) On pilot's power quadrant panel set RTR BK LOCK/BRAKE/OFF switch to OFF.

C

TARGET ASSEMBLY INSTALLATION (1)



NOTES

b. Install blade target assemblies

(1) Remove two screws from blade tip. (Install screws on target assembly nut plates.)

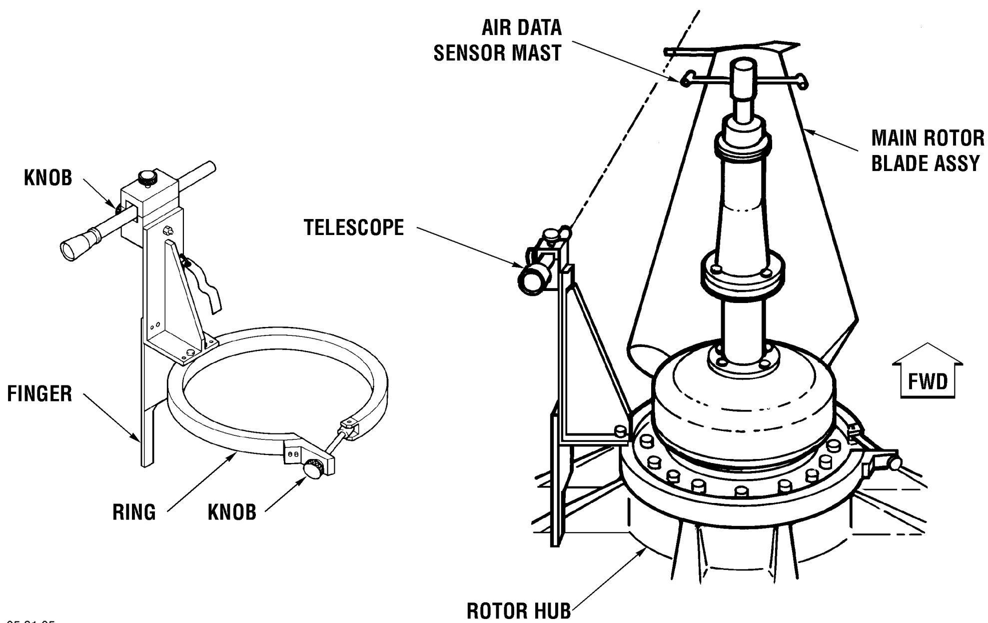
(2) Align blade target, on the tip end of each blade, with the target's cross hairs facing inboard.

(3) Install two socket head screws.

(4) Center target around screws and tighten screws.

C

TELESCOPE AND SUPPORT ASSEMBLY INSTALLATION (1)



05-91-05

NOTES

c. Install telescope support assembly

(1) Position rotor blade to be phased, over the nose of helicopter.

(2) Loosen the support ring knob and open the ring.

(3) Position the support around the air data sensor mast over the drive plate with the scope mount and locator on the left side of the rotor head, 90E from the bladed to be phased.

(4) Lower the support into the rotor hub positioning the locator finger on the leading edge side of the feathering bearing on the left side of the helicopter.

(5) Firmly seat the support into the rotor hub and tighten support clamp knob.

d. Install telescope in support

(1) Check scope cross hairs for centered position. If cross hairs are off, make adjustments using a target fifty feet away.

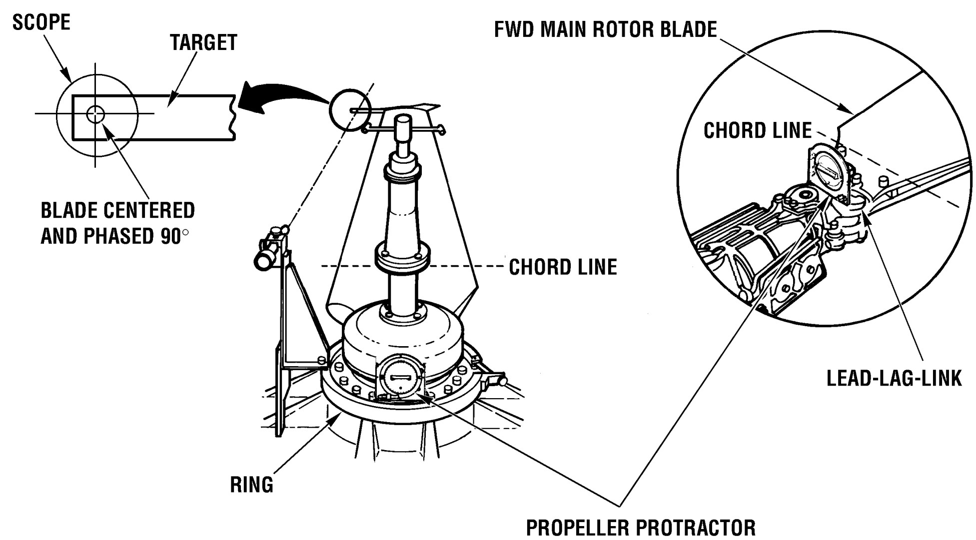
(2) Loosen the torque screw.

(3) Insert the scope into the support with the eyepiece facing the tail of the helicopter.

(4) Tighten torque screw finger tight.

C

BLADE PHASING PROCEDURES (1)



05-91-07

NOTES

4. Blade phasing

   a. Level lead-lag link

      (1) Set propeller protractor chord wise across the scope support ring and center leveling bubble.

      (2) Set leveled protractor on lead-lag link parallel to the chord line.

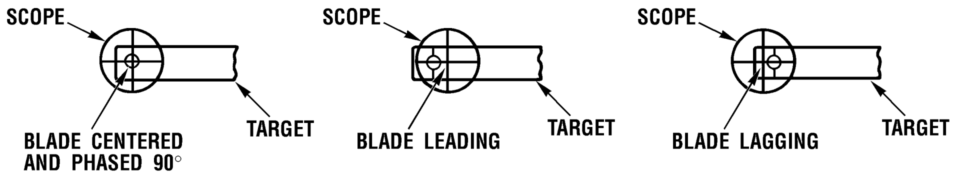
      (3) Lower pilot's collective stick to full down position.

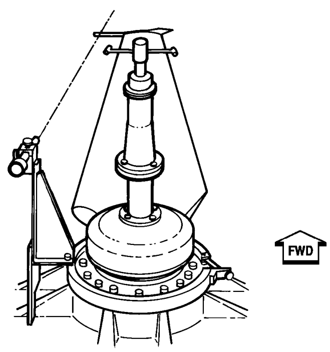
      (4) Move pilot's cyclic stick right or left until the protractor bubble is centered.

      (5) Set TRIM switch on the cyclic stick.

C

BLADE SITE READINGS (1)





05-91-09

NOTES

b. Scope the blades

(1) Sight through the scope eyepiece, adjusting elevation until cross hairs are aligned horizontally with blade tip target hole.

(2) If the center of the cross hairs are within the confines of the target hole, no damper adjustments are required.

(3) If the center of the cross hairs are outside the target hole, adjust the dampers an equal amount to obtain the correct sight picture.

5. Shut down procedures

(1) Shutdown and disconnect AGPU. (Electrical and hydraulic power.)

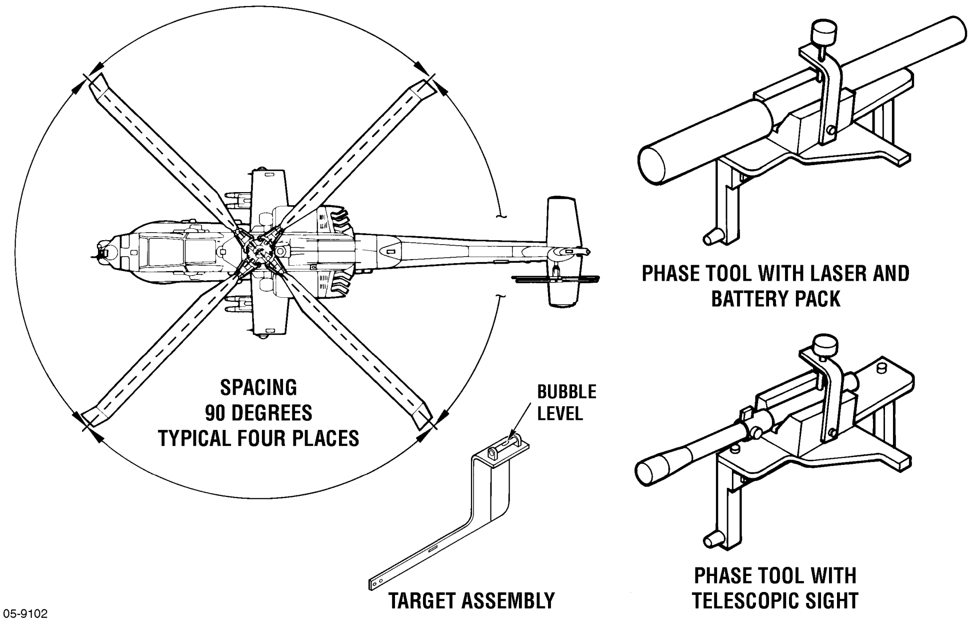
(2) Remove phasing equipment from helicopter.

(3) Install blade tip screws.

C

AH-64A MAIN ROTOR BLADE PHASING (2)

(BLADE PHASING KIT TELESCOPE AND LASER WITH BATTERY PACK)



NOTES

B. Main rotor blade phasing procedures using kit # NSN 1730-01-180-7610

1. Blade phasing is required to align the four main rotor blade assemblies to each other.

2. Components

   a. Phasing target assembly (with bubble level)

   b. Phasing tool (support)

   c. Telescope

   d. Laser with battery pack

3. Installation procedures

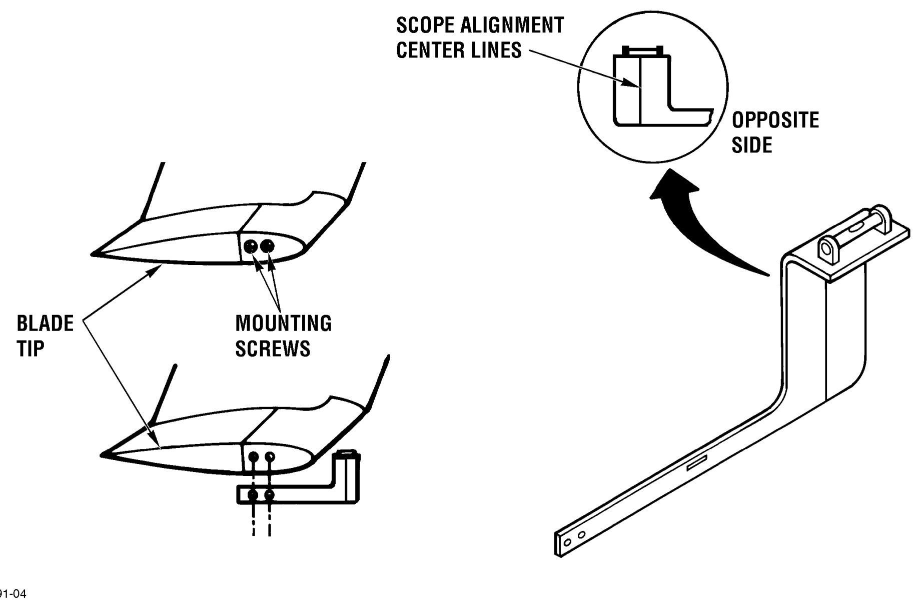
   a. Preliminary steps

      (1) Connect and apply auxiliary ground power unit (AGPU) electrical power and hydraulic power.

      (2) On pilot's power quadrant panel set RTR BK LOCK/BRAKE/OFF switch to OFF.

C

TARGET ASSEMBLY INSTALLATION (2)



NOTES

b. Install blade target assemblies

(1) Remove two screws from blade tip. (Install screws on target assembly nut plates.)

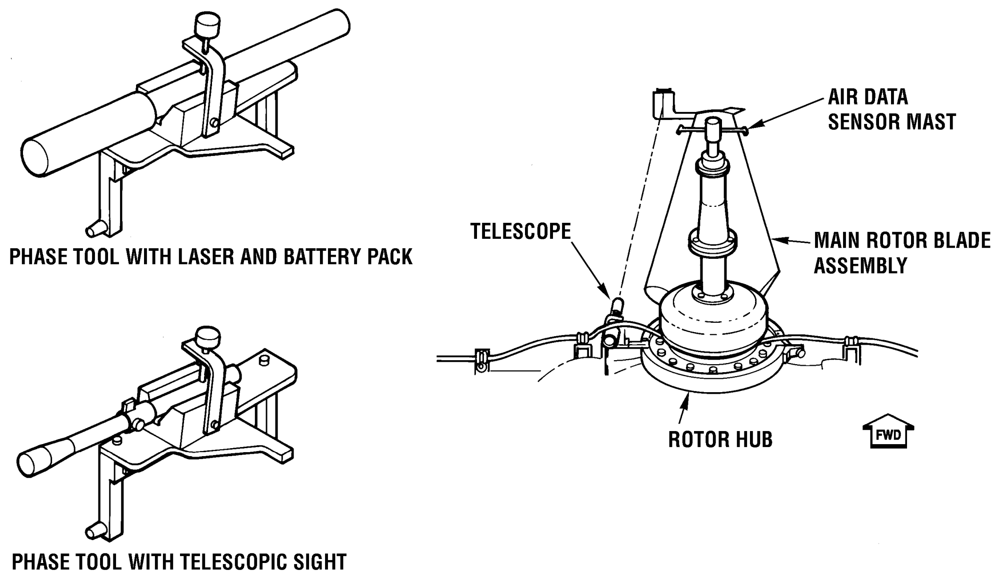
(2) Align blade target, on the tip end of each blade, with the target's cross hairs facing inboard.

(3) Install two socket head screws.

(4) Center target around screws and tighten screws.

C

TELESCOPE AND SUPPORT ASSEMBLY INSTALLATION (2)



05-91-06

NOTES

c. Install telescope support assembly

(1) Position rotor blade to be phased, over the nose of helicopter.

(2) slide the phasing tool into the main rotor head lifting point, on the left side of the rotor head, 90E from the bladed to be phased.

d. Install telescope in support

(1) Check scope cross hairs for centered position. If cross hairs are off, make adjustments using a target fifty feet away.

(2) Loosen the torque screw.

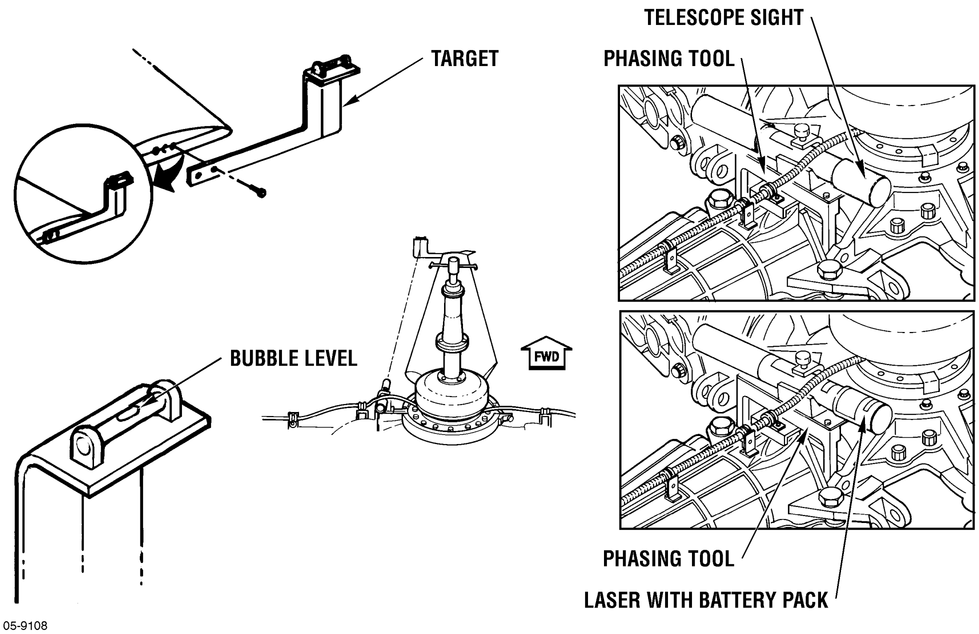
(3) Insert the scope into the support with the eyepiece facing the tail of the helicopter.

(4) Tighten torque screw finger tight.

C

BLADE PHASING PROCEDURES (2)

(WITH TELESCOPE, AND LASER WITH BATTERY PACK)



NOTES

4. Blade phasing

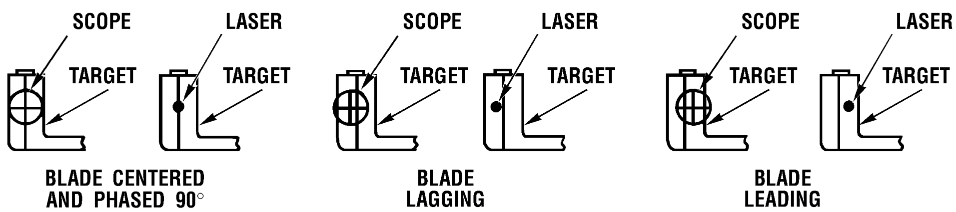
   a. Lower pilot's collective stick to full down position.

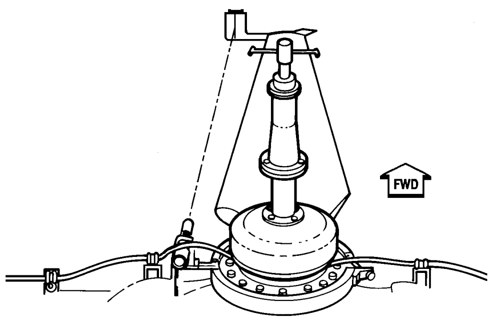
   b. Slowly move pilot's cyclic stick right or left until the target bubble is centered.

   c. Set TRIM switch on cyclic stick.

C

BLADE SITE READINGS (2)
(WITH PHASE TOOL, TELESCOPIC SIGHTS AND LASER WITH BATTERY PACK)





05-91-10

NOTES

d. Scope the blades

(1) Sight through the scope eyepiece, adjusting elevation until cross hairs are aligned horizontally with blade tip target hole.

(2) If the center of the cross hairs are within the confines of the target hole, no damper adjustments are required.

(3) If the center of the cross hairs are outside the target hole, adjust the dampers an equal amount to obtain the correct sight picture.

5. Shut down procedures

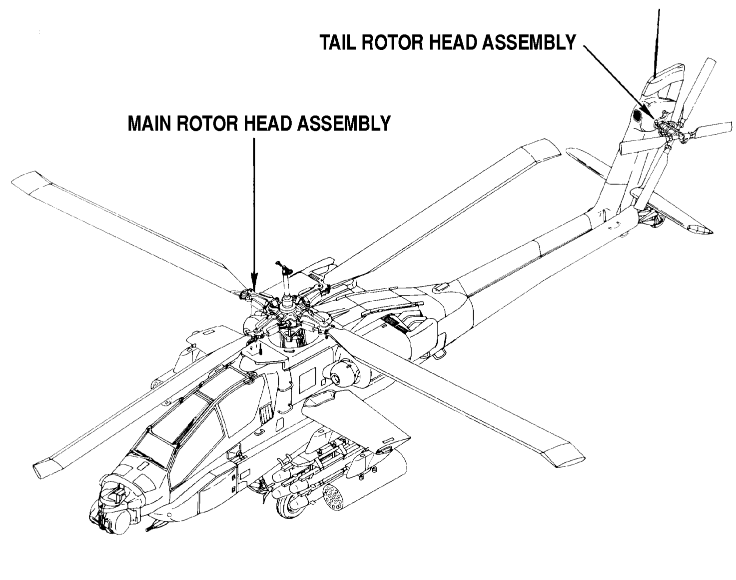
a. Shutdown and disconnect AGPU. (Electrical and hydraulic power.)

b. Remove phasing equipment from helicopter.

c. Install blade tip screws.

C

AH-64A ROTOR SYSTEM TRACK AND BALANCE



NOTES

A. Vibrations

1. Tracking and balancing of the rotor system reduces the vibration caused by an out of balance or out of track rotor system.

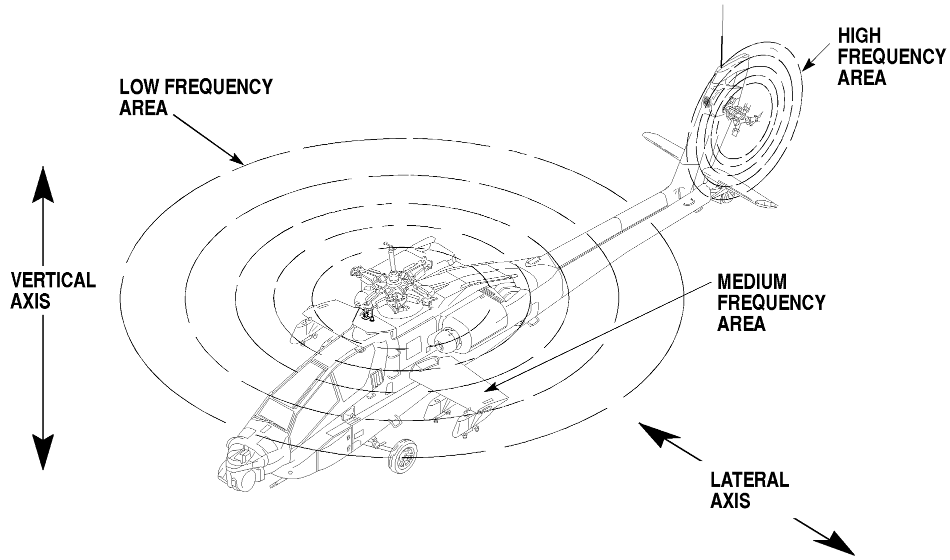
2. Low frequency vibrations are usually of a low magnitude type and are located around the main rotor system.

3. Medium frequency vibrations are usually of a low magnitude and are always caused by the non-rotating airframe components.

4. High frequency vibrations are of a high magnitude type and are usually centered around the tail rotor system.

C

TYPES OF VIBRATIONS



05-92-08

NOTES

B. Vibration causes

1. Low frequency vertical vibrations are caused by climbing, diving blades, blades out of track and are corrected by tracking the blades and making trim tab adjustments and/or adjustment of the main rotor pitch links.

2. Low frequency lateral vibrations are caused by uneven weight distribution, spanwise or chord wise around the rotor plane and are corrected by adding or subtracting weights.

3. Medium frequency vibrations are aerodynamically induced and are difficult but not impossible to correct. They are usually caused by loose airframe components.

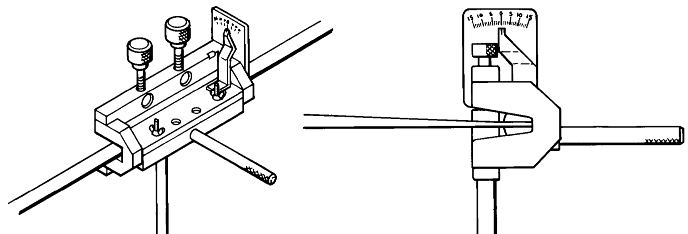
4. High frequency vibrations are usually caused by uneven weight distribution around the tail rotor plane of rotation, and are corrected by adding or subtracting weights to the tail rotor blades.

5. Other abnormal low frequency vibrations are aerodynamically induced and are difficult but not impossible to correct.

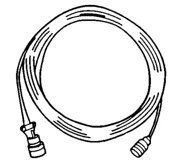
6. High frequency vibrations not induced by the tail rotor assembly are sometimes difficult to isolate. These are induced by any high speed rotating component (drive shaft and bearing hangar assemblies, couplings, gearboxes or loose assembly near a high speed rotating component).

C

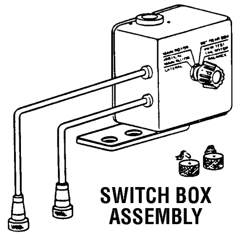
EQUIPMENT REQUIREMENTS (1A)



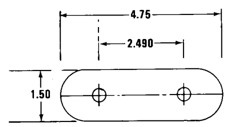
MAIN ROTOR BLADE TAB
ANGLE BENDING TOOL



TAIL ROTOR
ADAPTER
CABLE



SWITCH BOX
ASSEMBLY



BALANCE WEIGHT
TYPICAL

85-369

NOTES

A. Main rotor system track and balance using the Vibrex

1. Equipment requirements

a. Main rotor blade tab angle bending tool

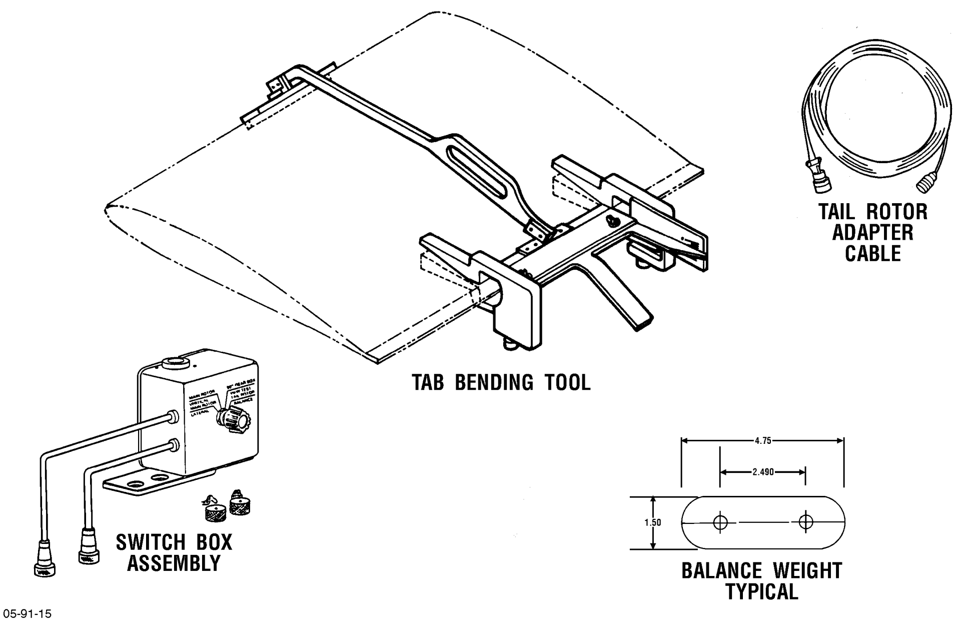
b. Adapter cable, tail rotor

c. Switch box assembly

d. Balance weights

C

EQUIPMENT REQUIREMENTS (1B)



NOTES

e. Tab bending tool with gage block

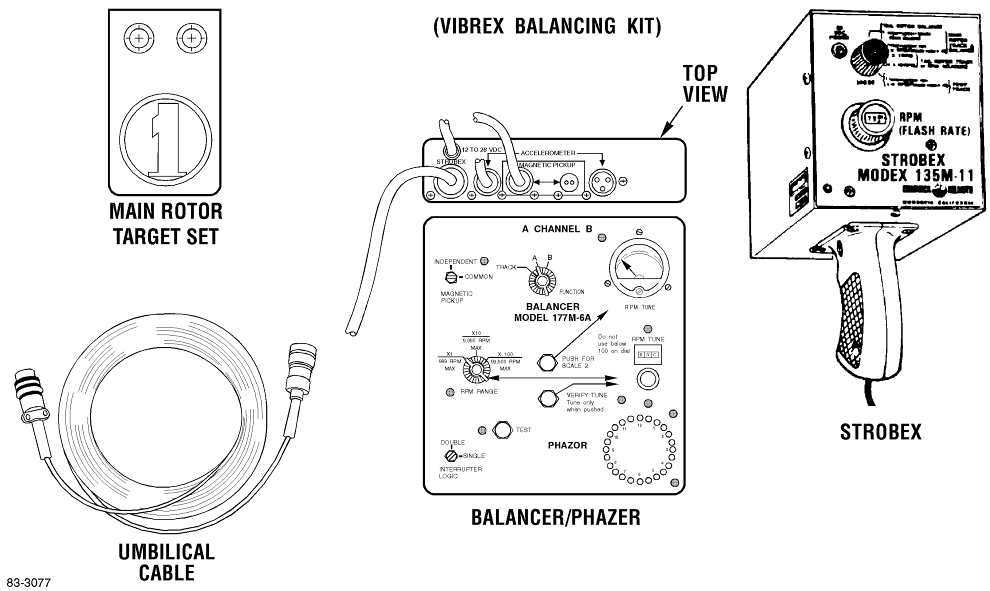
f. Adapter cable, tail rotor

g. Switch box assembly

h. Balance weights (typical)

C

EQUIPMENT REQUIREMENTS (2)



NOTES

i. Main rotor target set

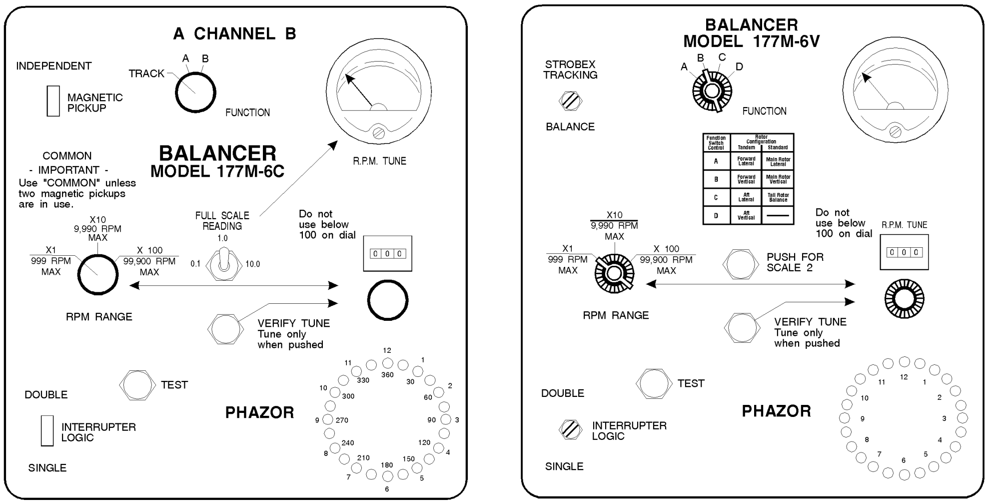
j. Umbilical cable

k. Balancer/Phazor

l. Strobex

C

EQUIPMENT REQUIREMENTS (3)



BALANCER/PHAZOR UNITS

05-91-13

NOTES

m. Balancing units

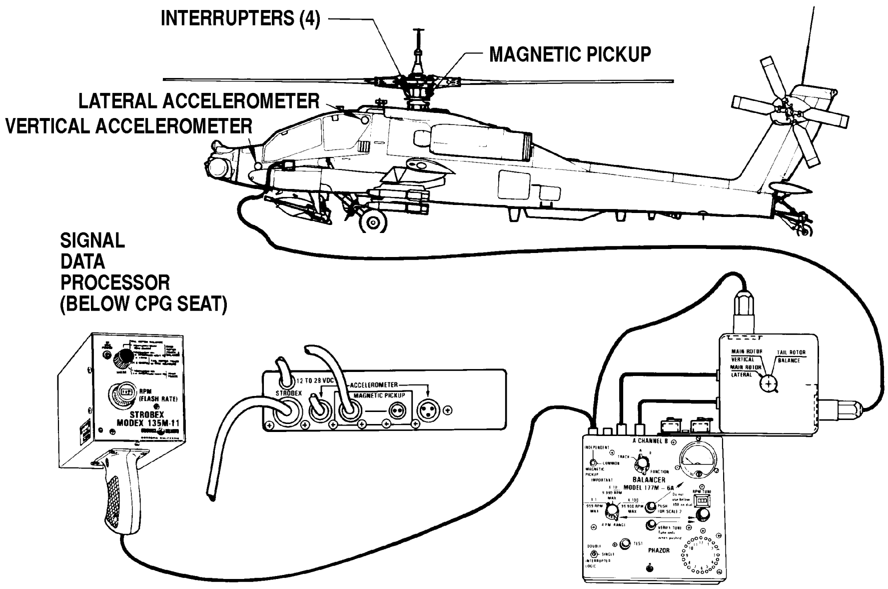
(1) Balancer/Phazor Unit Model 177M-6C

(2) Balancer/Phazor Unit Model 177M-6V

n. Maintenance platform

C

TRACK AND BALANCE MAIN ROTOR



05-92-18

NOTES

2. Main rotor tracking and balancing setup

   a. Connect balancer, strobex and switch box in CPG station.

   b. Place balancer, strobex and switch box in CPG station.

   c. Attach umbilical cable connector to footwell signal processor.

   d. Connect other end of the umbilical cable to the lower right receptacle of switch box assembly.

   e. Position switch box assembly base over the channel "B" and magnetic pickup receptacles, located on top of the balancer. Secure with two threaded caps.

   f. Connect the accelerometer and magnetic pickup leads of the switch box assembly into channel "A" and remaining magnetic pickup receptacle of the balancer.

   g. Attach strobex power cable connector to balancer.

   h. Attach 28 vdc cable connector from balancer to switch box top connector.

   i. Set controls on balancer and tracker.

      (1) Set balancer control (177M-6A)

         (a) Magnetic pickup switch to COMMON

         (b) Function switch to TRACK

         (c) RPM tune dial to 289 M/R RPM

         (d) RPM range switch to X1

         (e) Interrupter logic switch to DOUBLE

         (f) Set switch on switch box to M/R LATERAL

      (2) Set strobex tracker (135 M-11)

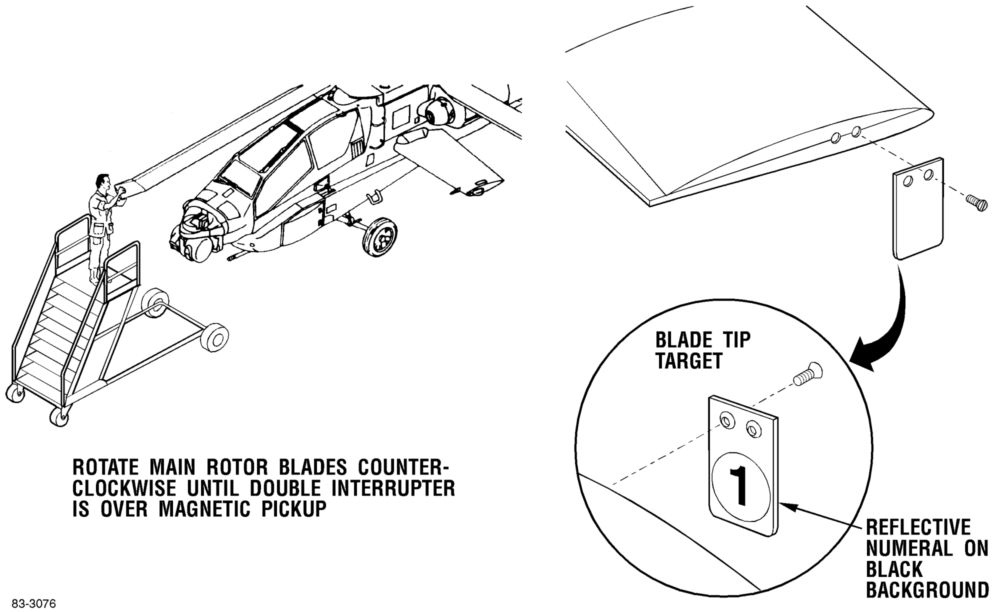
         (a) Mode switch - A

         (b) RPM flash rate - unimportant

         (c) Verify green 28 vdc power light (strobex) illuminates when trigger is pressed.

C

BLADE TIP TARGET INSTALLATION



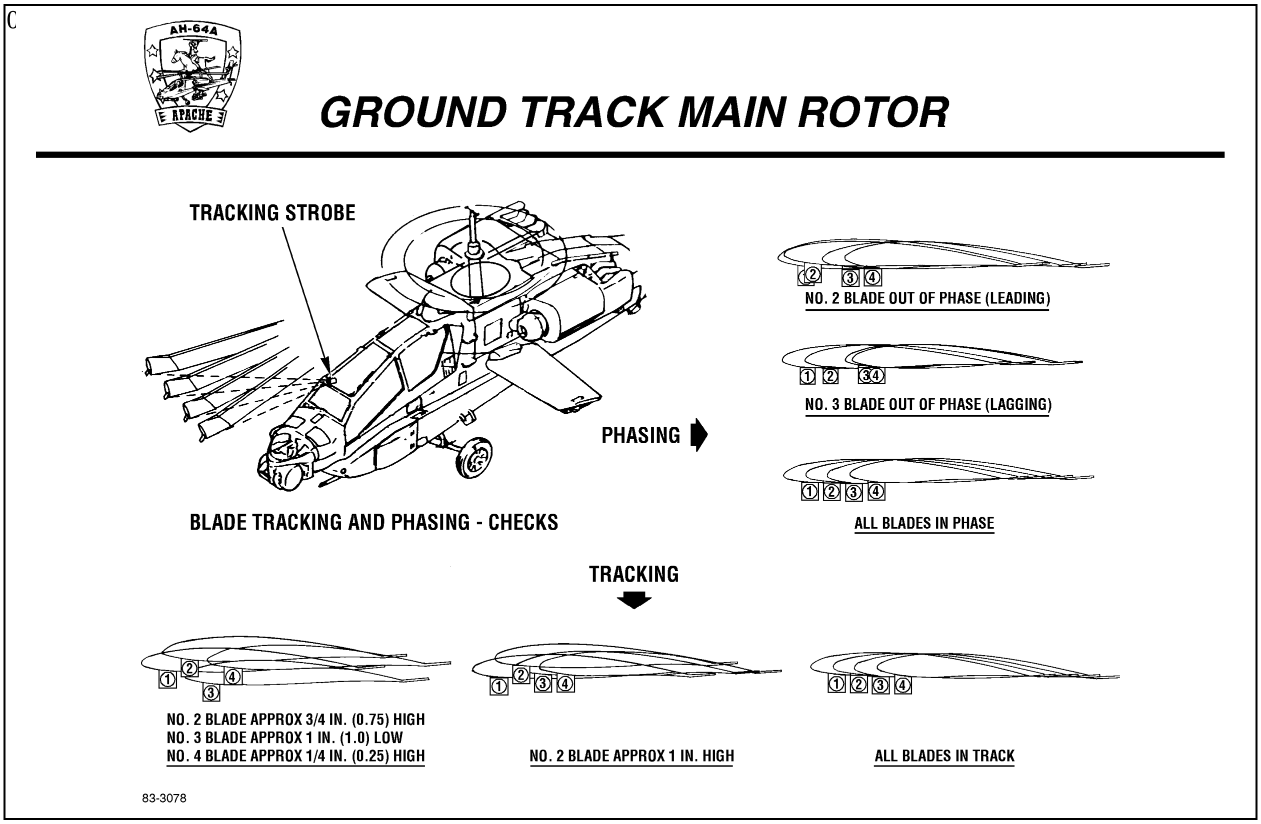
NOTES

j. Install tracking targets.

k. Rotate main rotor blades counterclockwise where double interrupter is over magnetic pickup.

l. Install tip target, with the reflective number 1 facing inboard.

m. Rotate blades counterclockwise and install reflectors 2, 3, and 4 in the same manner.


C
AH-64A
APACHE
GROUND TRACK MAIN ROTOR
TRACKING STROBE
BLADE TRACKING AND PHASING - CHECKS
PHASING
NO. 2 BLADE OUT OF PHASE (LEADING)
NO. 3 BLADE OUT OF PHASE (LAGGING)
ALL BLADES IN PHASE
TRACKING
NO. 2 BLADE APPROX 3/4 IN. (0.75) HIGH
NO. 3 BLADE APPROX 1 IN. (1.0) LOW
NO. 4 BLADE APPROX 1/4 IN. (0.25) HIGH
NO. 2 BLADE APPROX 1 IN. HIGH
ALL BLADES IN TRACK
83-3078

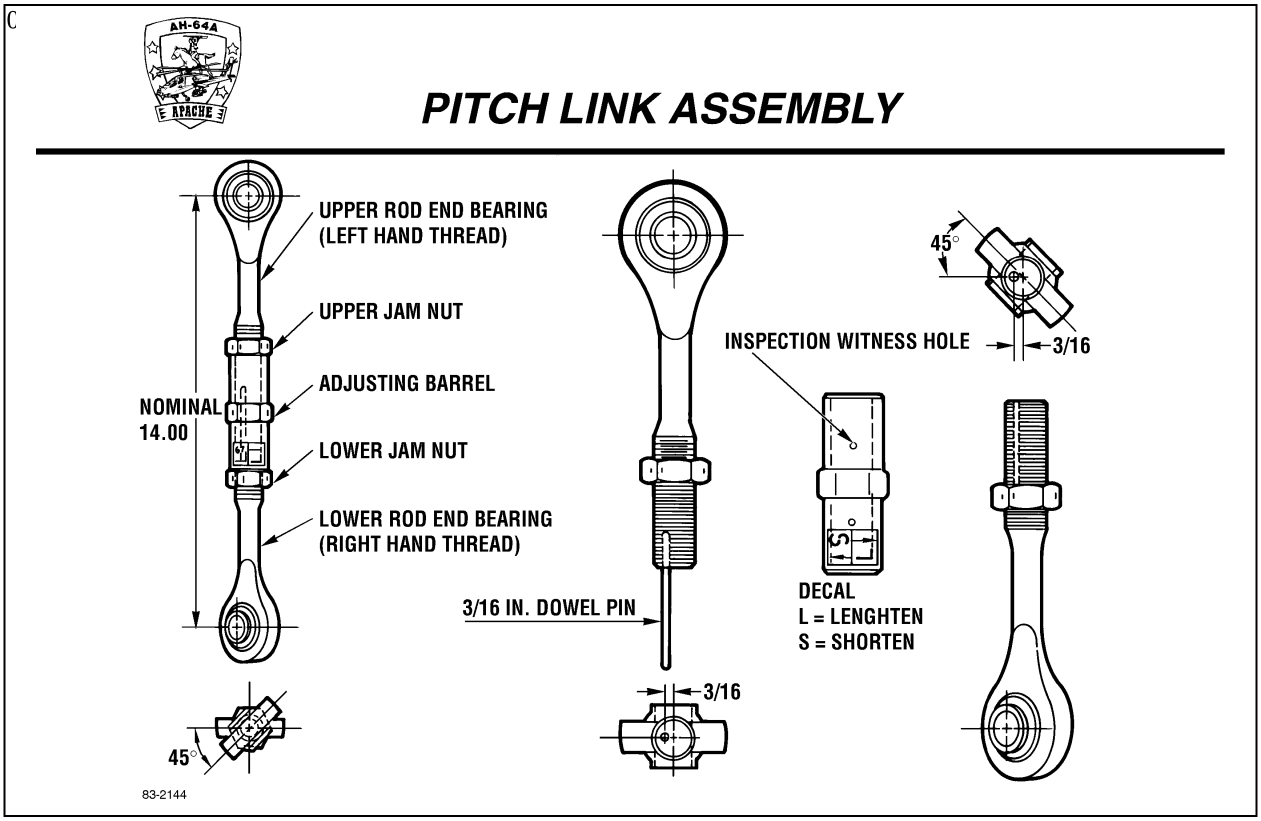
NOTES

B. Ground track main rotor blades

1. M/R ground track can be accomplished using only one engine.

2. Start either engine and bring rotor RPM to 100 percent.

3. View targets from CPG station with strobex at 12 o'clock position.


AH-64A
APACHE
PITCH LINK ASSEMBLY
UPPER ROD END BEARING
(LEFT HAND THREAD)
UPPER JAM NUT
ADJUSTING BARREL
NOMINAL
14.00
LOWER JAM NUT
LOWER ROD END BEARING
(RIGHT HAND THREAD)
45°
INSPECTION WITNESS HOLE
3/16
3/16 IN. DOWEL PIN
DECAL
L = LENGHTEN
S = SHORTEN
3/16
45°
83-2144

NOTES

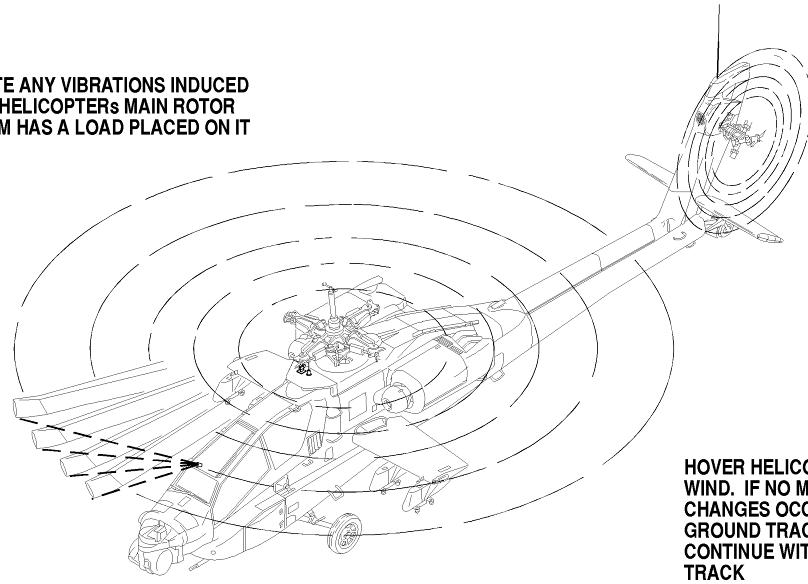
4. Make adjustments to pitch links to bring blades within 1/4 inch of each other.

   a. Prior to loosening jam nuts on pitch change link, mark barrel with grease pencil for reference.

   b. To determine which way to turn the pitch link barrel to raise or lower the blade, grasp the barrel with right hand, thumb extended up, turning the barrel the same direction as your fingers are pointed will raise the blade up. Turning barrel in the opposite direction will lower the blade. Turning barrel one flat will raise or lower the blade approximately 1/2 to 1 inch.

C

MAIN ROTOR HOVER TRACK AND BALANCE



NOTES

C. In flight main rotor track and balance procedure

1. Isolates and eliminates any vibration induced when the helicopter's main rotor system has a load placed on it.

2. Perform hover balance of main rotor (lateral).

   a. Install balancer, strobex, and switch box in CPG station and connect umbilical cable to footwell signal processor. Set control as previously set prior to performing ground track.

   b. With main rotor operating at 100 percent N_R, depress balancer phazor TEST button and observe test pattern (12:00, 3:00, 6:00, and 9:00 lights) in phazor ring-of-lights.

   c. Hover into wind with rotor operating at 100 percent N_R. Measure lateral balance IPS and clock angle.

   d. Observe single lighted light in phazor's ring-of-lights.

   e. Depress VERIFY TUNE button and adjust RPM TUNE dial while button is still pushed to return light to angle at which it was first observed.

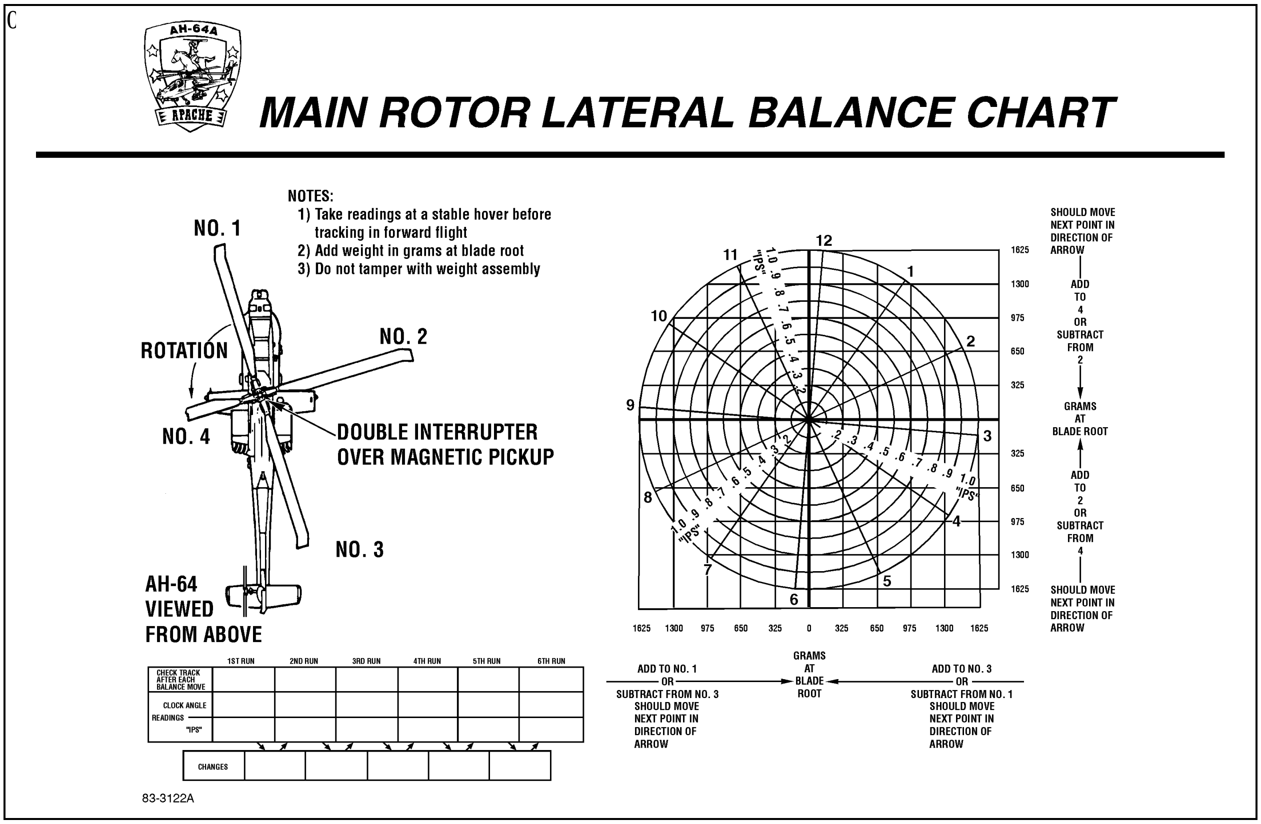
      (1) Release button, observe new light.

      (2) Depress button and adjust to match new un-pushed light.

      (3) Depress button and adjust again to match new un-pushed light.

      (4) Repeat steps always tuning to the un-pushed light until there are no changes in "clock angle" whether VERIFY TUNE button is pushed or released.

   f. Read Clock Angle from phazor and IPS level from meter with button released.


AH-64A
APACHE
MAIN ROTOR LATERAL BALANCE CHART
NOTES:
1) Take readings at a stable hover before tracking in forward flight
2) Add weight in grams at blade root
3) Do not tamper with weight assembly
NO. 1
NO. 2
ROTATION
NO. 4
DOUBLE INTERRUPTER OVER MAGNETIC PICKUP
NO. 3
AH-64 VIEWED FROM ABOVE
"IPS"
1625
1300
975
650
325
0
SHOULD MOVE NEXT POINT IN DIRECTION OF ARROW
ADD TO 4 OR SUBTRACT FROM 2
GRAMS AT BLADE ROOT
ADD TO 2 OR SUBTRACT FROM 4
ADD TO NO. 1 OR SUBTRACT FROM NO. 3 SHOULD MOVE NEXT POINT IN DIRECTION OF ARROW
ADD TO NO. 3 OR SUBTRACT FROM NO. 1 SHOULD MOVE NEXT POINT IN DIRECTION OF ARROW
1ST RUN
2ND RUN
3RD RUN
4TH RUN
5TH RUN
6TH RUN
CHECK TRACK AFTER EACH BALANCE MOVE
READINGS
CLOCK ANGLE
"IPS"
CHANGES
83-3122A

NOTES

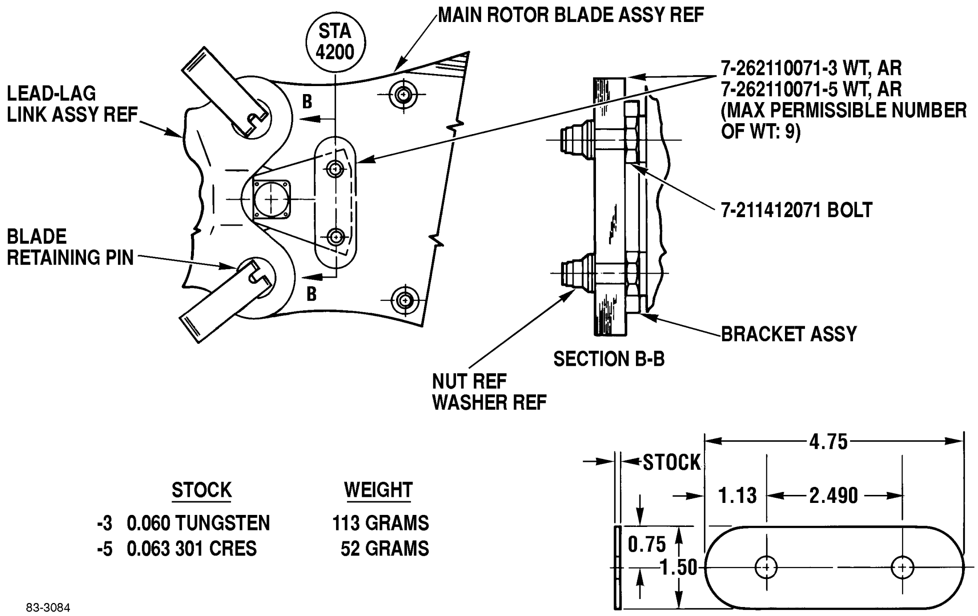
g. Record in data section of main rotor balancing, Chart number 1.

h. Blade tip cap weights are used for static balancing against a master blade, and are not to be tampered with.

i. If the initial IPS reading exceeds 1.0, divide the IPS reading by 2 (or some number that will yield a result of less than 1.0) and plot the new number on the chart. The indicated weight change must then be multiplied by 2 (or number used) for weight correction. Do not make fine balance adjustments until the rotor blades are in track within 1/2 inch of each other through the forward speed range.

C

BALANCE WEIGHT-MAIN ROTOR BLADE



STOCK	WEIGHT
-3 0.060 TUNGSTEN	113 GRAMS
-5 0.063 301 CRES	52 GRAMS

83-3084

NOTES

j. If IPS exceeds 0.3, balance weights must be added or subtracted from the blade root, station 42.0.

k. Nine weights maximum may be attached at the blade root, and not to exceed 1000 grams.

l. The mass of the weights depend on the material and are approximately

(1) 7-262110071-3 - 113 grams (0.060 inch tungsten)

(2) 7-262110071-5 - 52 grams (0.063 inch 301 cres.)

m. If lateral balance cannot be reduced to 0.3 IPS or less by adding the maximum number of weights, an inspection of the dampers and rotor head should be conducted.

3. Perform main rotor hover and forward flight tracking

a. Set switch box function switch to TRACK.

b. Track helicopter until rotor blades are within 1/2 inch of each other from hover to 160 knots or VH (whichever is lower).

c. If hover track differs from ground track by more than 2 inches, correct track by bending tab on out of track blades between stations 0 and 3. Blades must track within 1/2 inch.

4. Main rotor forward flight track and balance procedure

a. Set balancer set FUNCTION switch to TRACK.

C

MAIN ROTOR BLADE TAB ADJUSTMENT CHART

IN-FLIGHT TRACKING

60 KNOTS

BLADE VERTICAL SPREAD	BLADE # 1	2	3	4	POCKET
2"					
1 1/2"					4 — 10
1"					5 — 10
1/2"					6 — 10
ON LINE					
1/2"					6 — 10
1"					5 — 10
1 1/2"					4 — 10
2"					

80 KNOTS

BLADE VERTICAL SPREAD	BLADE # 1	2	3	4	POCKET
2"					
1 1/2"					5 — 10
1"					6 — 10
1/2"					7 — 10
ON LINE					
1/2"					7 — 10
1"					6 — 10
1 1/2"					5 — 10
2"					

100 KNOTS

BLADE VERTICAL SPREAD	BLADE # 1	2	3	4	POCKET
2"					
1 1/2"					6 — 10
1"					7 — 10
1/2"					8 — 10
ON LINE					
1/2"					8 — 10
1"					7 — 10
1 1/2"					6 — 10
2"					

120 KNOTS

BLADE VERTICAL SPREAD	BLADE # 1	2	3	4	POCKET
2"					
1 1/2"					7 — 10
1"					8 — 10
1/2"					9 — 10
ON LINE					
1/2"					9 — 10
1"					8 — 10
1 1/2"					7 — 10
2"					

140 KNOTS

BLADE VERTICAL SPREAD	BLADE # 1	2	3	4	POCKET
2"					
1 1/2"					8 — 10
1"					9 — 10
1/2"					10
ON LINE					
1/2"					10
1"					9 — 10
1 1/2"					8 — 10
2"					

1. Fly to highest achievable air speed (until blade pack spread is 3 inch). Record trend.
2. Locate the airspeed box at which the blade first exceeds a .5 inch spread.
3. Bend indicated pockets one degree up or down as required.
4. Perform in-flight check of blade spread. If bend was excessive, return one or two of the most outboard pockets to original position.
5. Repeat as required to refine track.

EXAMPLE:

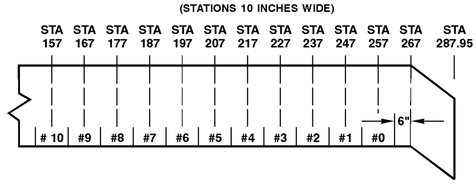
100 KNOTS

BLADE VERTICAL SPREAD	BLADE # 1	2	3	4	POCKET
2"					
1 1/2"				•	6 — 10
1"					7 — 10
1/2"					8 — 10
ON LINE	•	•	•		
1/2"					8 — 10
1"					7 — 10
1 1/2"					6 — 10
2"					

1. Blade # 4 flies 1 1/2" high at 100 knots.
2. Bend pockets 6 through 10 down 1 degree.

TAB BENDING STATIONS FOR BLADE TRACKING

(STATIONS 10 INCHES WIDE)



05-9403

NOTES

b. After ground track is within 1/4 inch and hover lateral balance is 0.3 IPS or less, track blades at airspeeds of 60, 80, 100, 120, 140 or VNE knots straight and level flight.

c. Fly to highest achievable airspeed. Do not exceed VH or airspeed at which blade track exceeds 3 inches. Record trend.

d. If any blade remains out of track the same amount at all airspeeds, correct track on that blade by adjusting pitch link.

e. Locate the airspeed box at which the blade first exceeds a .5 inch spread.

f. Bend indicated pockets one degree up or down as required.

g. Perform in-flight check of blade spread. If bend was excessive, return one or two of the most outboard pockets to original position.

h. Repeat as required to refine track. Track should be within 1/2 inch at all airspeeds. Record final tab bend angle for each section.

i. When all tracking criteria are met, check hover balance. If IPS exceeds 0.3 IPS, correct balance.

j. Determine the most stable blade as early in the tracking procedures as possible and reference all other blade adjustments to this blade. Minor changes to the pitch links may be required to preclude excessive tab bending. A blade that is high or low at all forward speeds including hover would be a good example.

5. Perform main rotor high speed vibration survey (balance in turns)

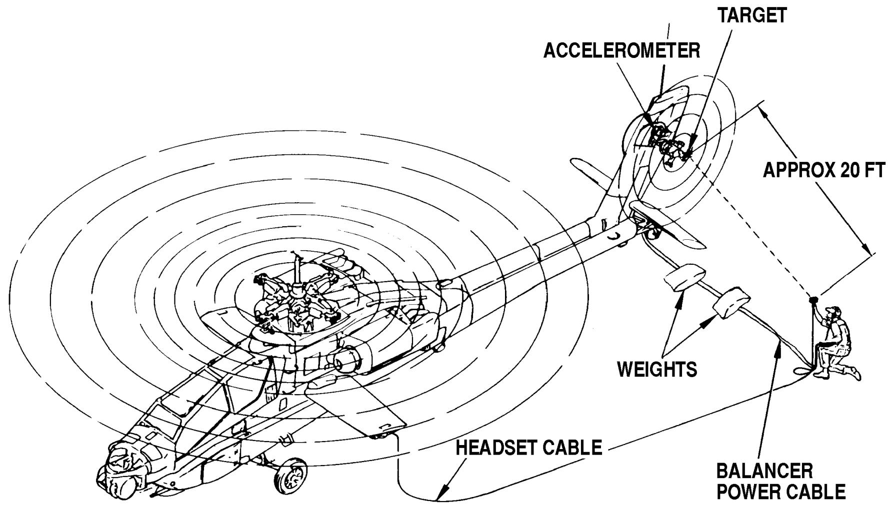
a. Upon conclusion of straight and level tracking, level flight turns are to be conducted.

b. Perform turns at 45 degree bank and 110 knots airspeed.

c. Check vertical and lateral balance by setting switch box selector to appropriate position. Vertical and lateral balance must not exceed 0.76 IPS during turns.

C

TAIL ROTOR BALANCING PROCEDURES



NOTES

A. Tail rotor assembly balance procedures

1. Balancing the tail rotor produces a vibration free tail rotor system.

2. High frequency vibration causes damage to the helicopter airframe by producing cracks, popped rivets, worn bearings and rod-end bearings.

3. Occasionally, tail rotor vibrations are felt by the aircrew through the directional control pedals.

4. High frequency vibrations can cause complete tail rotor failure if not corrected.

B. Preparation of the helicopter for tail rotor balance

1. Remove tail rotor gearbox fairing.

2. Install accelerometer adapter bracket PN 3383 and accelerometer (from Vibrex Kit) onto uppermost casing stud of tail rotor gearbox.

3. Attach one end of cable to accelerometer and the other end of cable to balancer.

4. Connect the maintenance headset with adapter cord assembly to the left wing ICS jack.

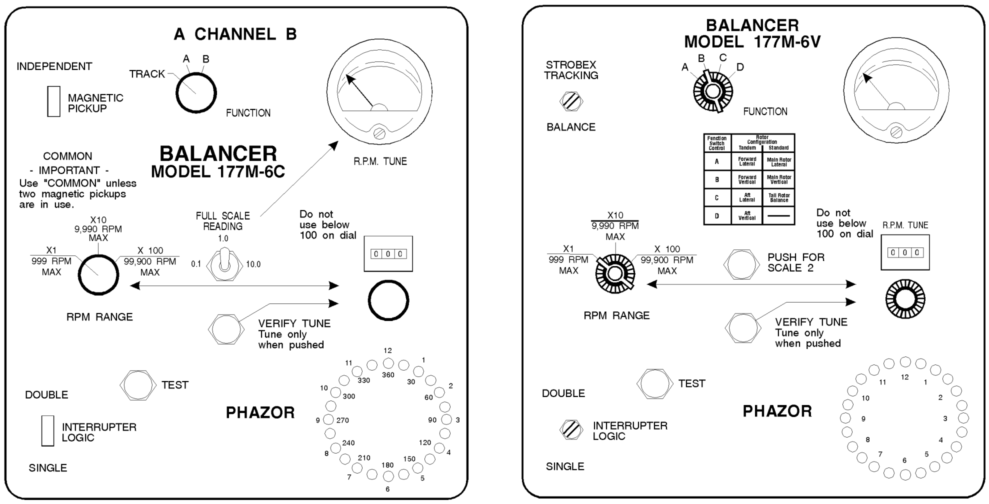
5. Connect 28 vdc power cable to balancer. Route cable to aft avionics bay and attach to connect J111.

6. Attach a single reflective tape to the grip on one of the two outboard blades. (It is unimportant which blade is used.)

7. This blade becomes the target blade. The blade immediately following the target blade clockwise is "A". The next "B" and then "C".

C

EQUIPMENT REQUIREMENTS (3)



BALANCER/PHAZOR UNITS

05-91-13

NOTES

8. Set controls on balancer

    a. FUNCTION switch - A

    b. RPM switch - X10

    c. RPM Tune Dial - 140

    d. Other balancer settings are not needed for this task.

9. Accelerometer signal check

    a. Verify signal path from accelerometer to balancer by using a screwdriver handle or similar device to tap lightly on the accelerometer.

    b. Several taps should cause the "IPS" (inches per second) meter to deflect up scale momentarily.

C. Balancing the tail rotor

1. With helicopter operating at 100 percent N_R, face the tail rotor disc. Observe the single reflective grip target with the strobex noting its angular position on the disc.

2. While still viewing target, depress the VERIFY TUNE button. The angular position of the target will probably change; if it does, rotate the RPM tune button while the verify tune is still pushed, to return target to its initial angular position.

3. Release VERIFY TUNE button, observe new un-pushed angle, press, and adjust again to match new un-pushed angle.

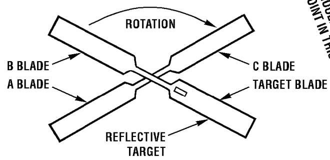
4. Repeat procedure until there is no change whether the button is pushed or released.

5. Read clock angle of the grip target with strobex without verify tune button pushed, and IPS balance meter without strobex flashing.

C

TAIL ROTOR BALANCE CHART

NOTES:
1) Tail rotor turns 1400 RPM at 100% NR. Set balancer tuner to 140 times 10
2) Take readings with pedals centered from vertical accelerometer added to tail rotor gearbox
3) Weight addition requires removal and replacement of blade tip cap
4) Phazor indications are meaningless during tail rotor balance

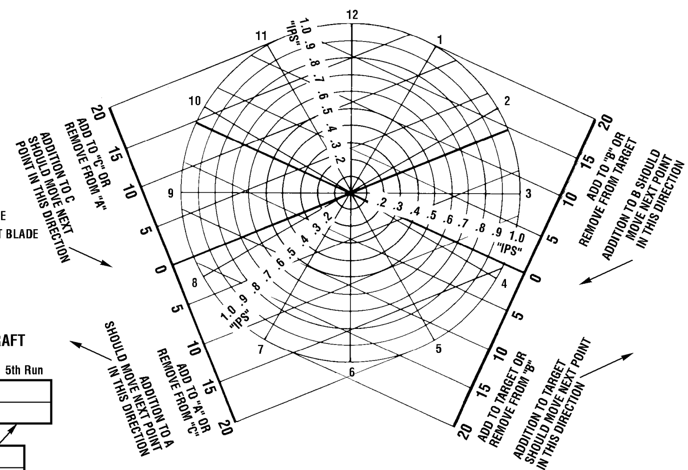


TAIL ROTOR VIEWED FROM LEFT SIDE OF AIRCRAFT

	1st Run	2nd Run	3rd Run	4th Run	5th Run
Clock Angle					
Readings "IPS"					

Changes	Target				
	A Blade				
	B Blade				
	C Blade				

830168-3125-C



TAIL ROTOR BALANCE CHART

NOTES

6. Record clock angle and IPS readings on the tail rotor balance chart.

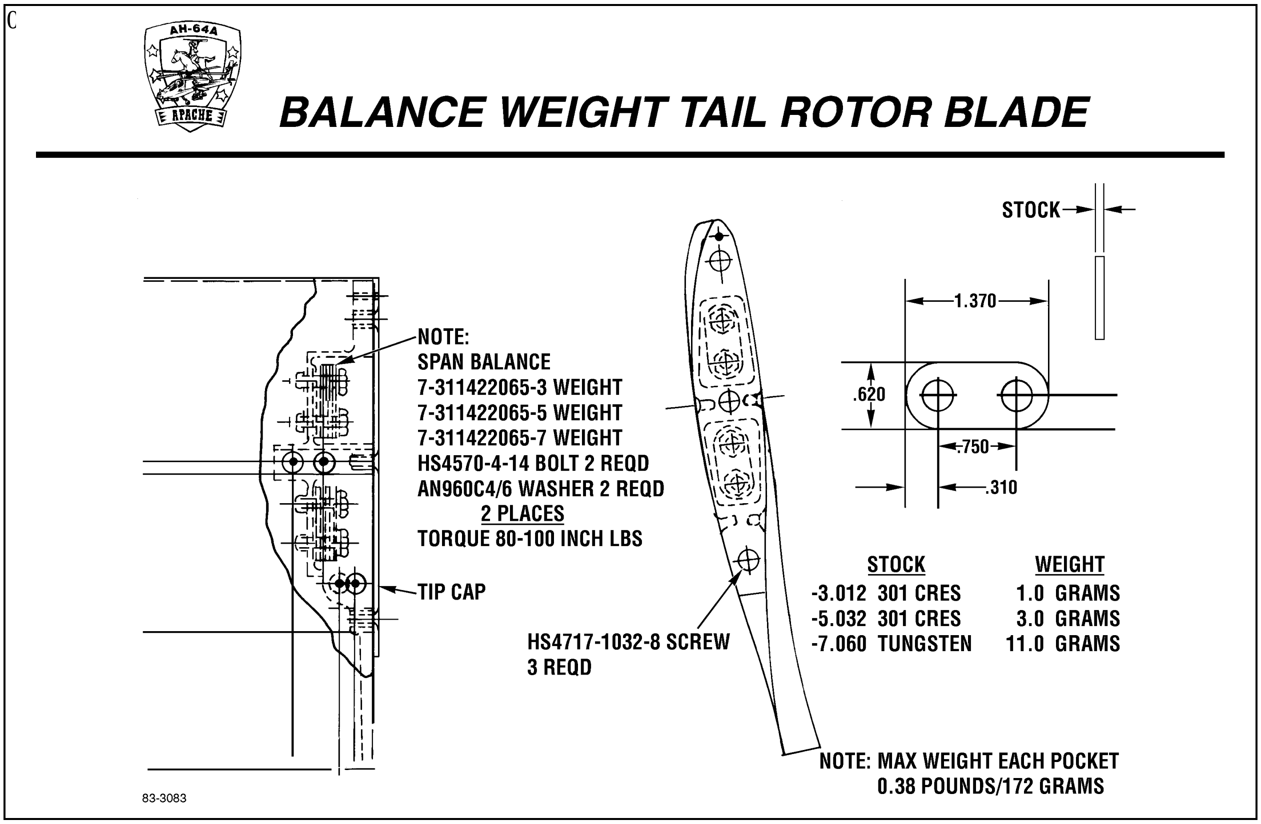
   a. If IPS reading is 0.2 or less, no balance weight change is required. Tail rotor balance is acceptable.

   b. If IPS reading exceeds 0.2, shut down helicopter for balance weight change.

      (1) Plot points on chart at intersection of clock and IPS, labeling it number 1. Sketch lines parallel to fine lines of chart and out to heavy border.

      (2) If the initial IPS reading exceeds 1.0 divide that IPS reading by 2 (or some number that will yield a result of less than 1.0) and plot the new number on the chart. The indicated weight change must then be multiplied by 2 (or number used) for weight correction.

      (3) Select large weight change (whichever is furthest from zero) for the first run.


C
AH-64A
APACHE
BALANCE WEIGHT TAIL ROTOR BLADE
NOTE:
SPAN BALANCE
7-311422065-3 WEIGHT
7-311422065-5 WEIGHT
7-311422065-7 WEIGHT
HS4570-4-14 BOLT 2 REQD
AN960C4/6 WASHER 2 REQD
2 PLACES
TORQUE 80-100 INCH LBS
TIP CAP
HS4717-1032-8 SCREW
3 REQD
STOCK
1.370
.620
.750
.310
STOCK WEIGHT
-3.012 301 CRES 1.0 GRAMS
-5.032 301 CRES 3.0 GRAMS
-7.060 TUNGSTEN 11.0 GRAMS
NOTE: MAX WEIGHT EACH POCKET
0.38 POUNDS/172 GRAMS
83-3083

NOTES

(4) Remove tail rotor blade tip cap.

(5) Four bolts hold the weights in two separate mounting points requiring two bolts for each mount point. One-half of required weight correction should be made at each mount point.

(6) Three different size weights are used for balancing the tail rotor.

(a) 7-311422065-3 - 1.0 gram (0.012 Cres)

(b) 7-311422065-5 - 3.0 gram (0.032 Cres)

(c) 7-311422065-7 - 11.0 gram (0.060 Cres tungsten)

(7) Select proper weights to be installed or removed.

(8) Install tail rotor blade tip weights and torque bolts.

(9) Position blade tip cap on tip of blade. Install 3 screws and torque.

(10) Record the amount of weight(s) and on which blade they were installed, on tail rotor balance chart.

(11) Repeat readings, labeling point number 2. If the move line (points number 1 and number 2 connected) went in the correct direction, proceed to balance to 0.2 IPS or less, making all required changes.

(12) If not, correct clock angles of the graph using clock angle corrector number 3597.

(13) Re-plot second point on corrected chart, then make all required changes.

7. Disconnect accelerometer and 28 vdc power cable. (Do not disconnect and stow balancer or strobex; hover balance and in-flight track and balance to be done next.)

8. Remove accelerometer bracket and reinstall tail rotor gearbox fairing.

ROTOR ANALYSIS DIAGNOSTIC SYSTEM-ADVANCED TECHNOLOGY

(RADS-AT)

PURPOSE

- **Analyzes rotor vibrations**
- **Identifies recommended maintenance procedures to correct the vibrations**

DESCRIPTION

- **Lightweight, portable test set that contains sophisticated measurement technology designed to operate with a minimum of operator in-flight interface**
  - **Measures, records, and processes vibration and blade position information**
  - **Diagnoses information and supplies maintenance personnel with corrective actions**
  - **Maintains a data base of measurements, diagnostic outputs, and aircraft history**

05-94-04

NOTES

A. Rotor system track and balance using RADS-AT

1. The RADS-AT analyzes rotor system vibrations and recommends maintenance procedures to correct the vibrations.

2. The RADS-AT is a lightweight, portable test set that contains sophisticated measurement technology, and is designed to operate with a minimum of in-flight operator interface.

3. The RADS-AT

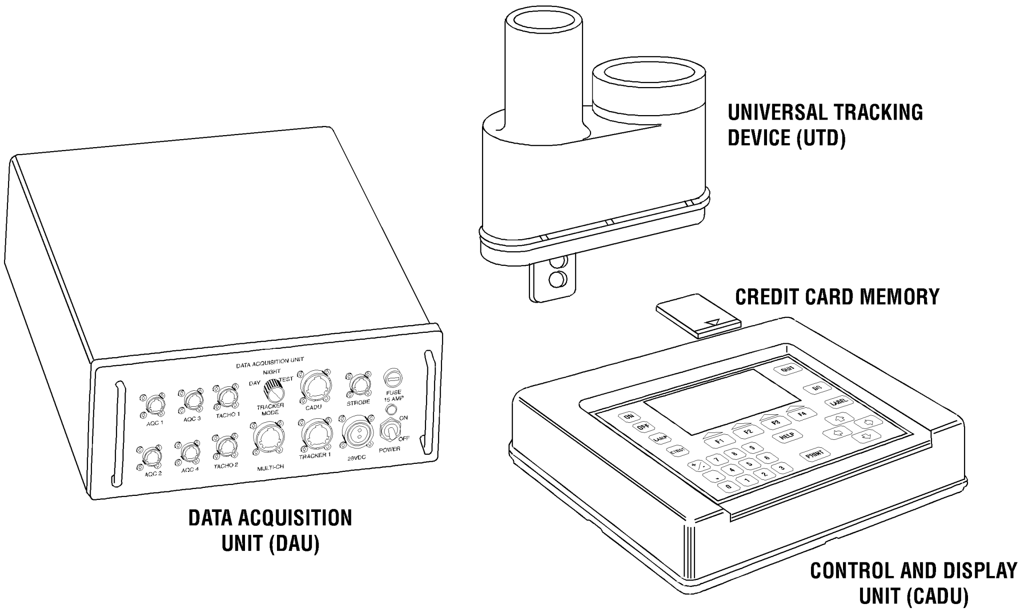
   a. Measures, records, and processes vibration and blade position information.

   b. Diagnosis information and supplies maintenance personnel with corrective actions.

   c. Maintains a data base of measurements, diagnostic outputs, and aircraft history.

C

RADS-AT BASIC KIT



05-94-05

NOTES

4. RADS-AT System components

   a. Component case marked AVA BASIC KIT with the following components

      (1) Data Acquisition Unit (DAU)

      (2) Control and Display Unit (CADU)

      (3) Universal Tracking Device (UTD)

      (4) Credit Card Memory (CCM) device

   b. Component case marked ADAPTER KIT with the following components

      (1) Interconnection cables

      (2) UTD mounting bracket

      (3) Multi-pin connector cable

      (4) Accelerometer mounting blocks

      (5) Optical RPM Sensor and bracket

5. Equipment requirements for performing AH-64 vibration analysis

   a. Accessories kit, rotor track and balance

   b. Aircraft mechanic's tool kit

   c. RADS-AT track and balance system items

      (1) Data acquisition unit (DAU) in canvas carrying case

      (2) Control and display unit (CADU)

      (3) 10-ft CADU to DAU cable

      (4) Universal tracking device (UTD)

      (5) 25-ft UTD cable

      (6) AH-64 ABT bracket

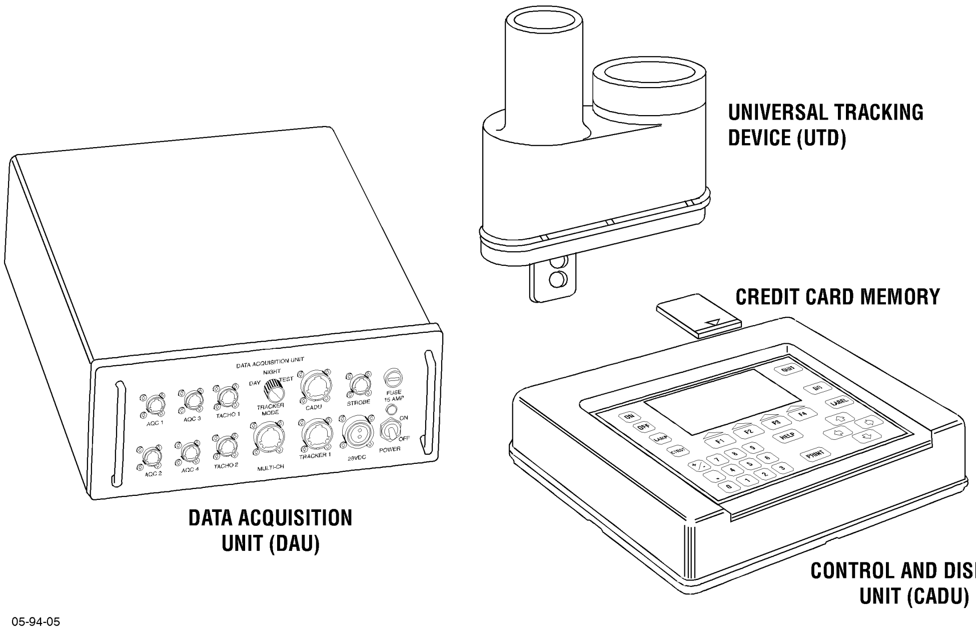
      (7) 6-ft AH-64 to DAU cable

      (8) AH-64 aircraft setup file (installed in CADU)

      (9) Accelerometer cable

C

RADS-AT BASIC KIT



NOTES

(10) Optical RPM sensor

(11) Optical RPM sensor mounting bracket

(12) Balance weights (as required)

(13) Lockwire (.032 dia.)

B. RADS-AT setup

1. Initial set-up

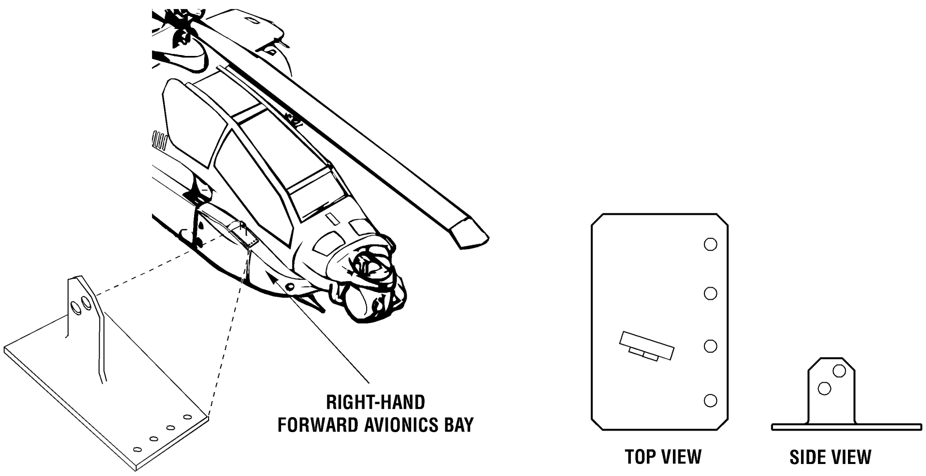
a. Remove RADS-AT blade tracking equipment from case.

b. Using long straps and D-rings, mount DAU to outboard side of co-pilots left armor plate with connectors facing forward.

c. Connect breakout cable to signal processing box beneath and to the right of co-pilots seat.

d. Route cable behind co-pilots seat and around the DAU.

INSTALL TRACKER



NOTES

2. Install tracker.

   a. Remove four aircraft screws at top and all the way forward on the right-hand forward avionics bay (FAB) (near a forward edge of the co-pilots canopy).

   b. Install tracker bracket on FAB with airframe screw holes on leading edge.

   c. Attach tracker bracket with airframe screws. (if not available use NAS1305-xx bolts of suitable length).

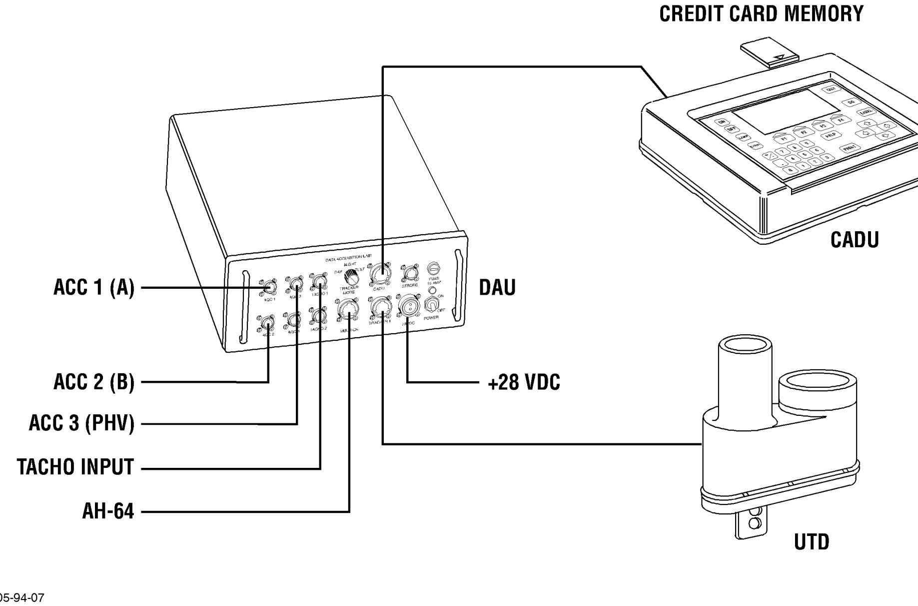
   d. Attach tracker to tracker bracket with arrow in tracker body pointing in the direction of main rotor rotation.

   e. Connect tracker cable to tracker, and route along breakout cable. Connect to DAU receptacle marked TRACKER. Store slack in cable in map holder near co-pilots right knee.

   f. Ensure tracker select switch is set to the DAY position.

C

TYPICAL RADS-AT TEST SETUP CONFIGURATION



NOTES

g. Connect breakout cable to DAU receptacles marked MULTICHANNEL, TACHO1, and +28 VDC.

h. Connect the 10-ft CADU to DAU cable to both units.

i. Turn on the DAU.

j. Turn on the CAD.

3. Bypass installation instructions

a. Remove connector from lateral accelerometer above and to the rear of the pilots head.

b. Connect accelerometer cable (found in the basic kit) to the accelerometer, and connect to the DAU ACC 1 connector.

c. Install accelerometer bracket (found in the basic kit) on right-hand instrument panel, near co-pilots right knee, third screw down.

d. Install accelerometer on bracket with the connector facing down.

e. Attach accelerometer cable (found in the basic kit) to the vertical accelerometer, and connect to the DAU ACC 2 connector.

f. Disconnect existing cable from magnetic RPM sensor, and secure with a tie-wrap to any location that will not interfere with any moving component or flight controls.

g. Connect Magnetic RPM Sensor Cable (found in the basic kit) to the Magnetic RPM Sensor, and route past the gearbox inspection panel, outside the aircraft, and back in through the co-pilot's canopy door (next to the tracker cable). Connect to the DAU TACHO 1 connector.

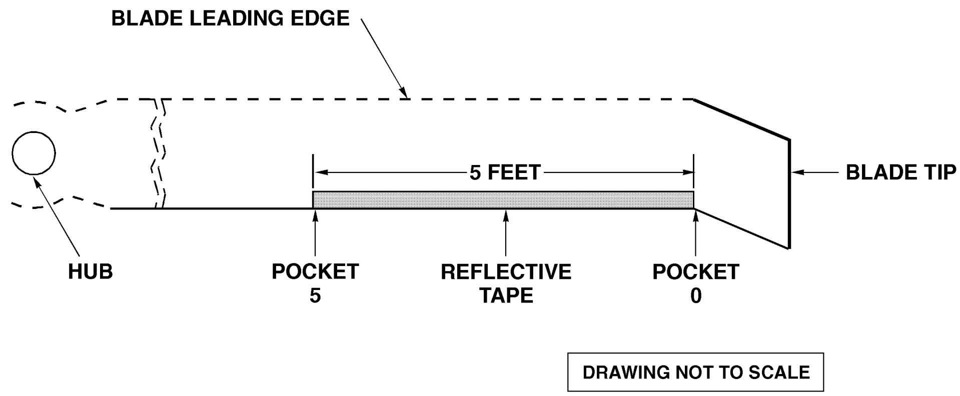
h. Connect tracker cable to tracker, and route along breakout cable. Connect to the DAU receptacle marked Tracker. Store slack in cable in the map holder near the co-pilot's right knee.

i. Connect the 10-ft CADU to DAU cable to both units.

j. On the CADU, select "Aircraft Type" as NB-64, then operate the system as normal.

C

TAPE OF BLADES



05-94-08

NOTES

4. Night-time operations

   a. Ensure underside, trailing edge of all blades are as clean as possible for maximum adhesion of tape.

   b. Place one single 5-ft strip of reflective tape along the underside, trailing edge (on the tab) of the blade from tab pocket 0 to tab pocket 5.

   c. Ensure that the tracker select switch on the DAU is set to NIGHT position.

C. Track and balance main rotor

1. Track and balance of the main rotor blades should be performed when any of the following occurs

   a. One or more blades have been changed.

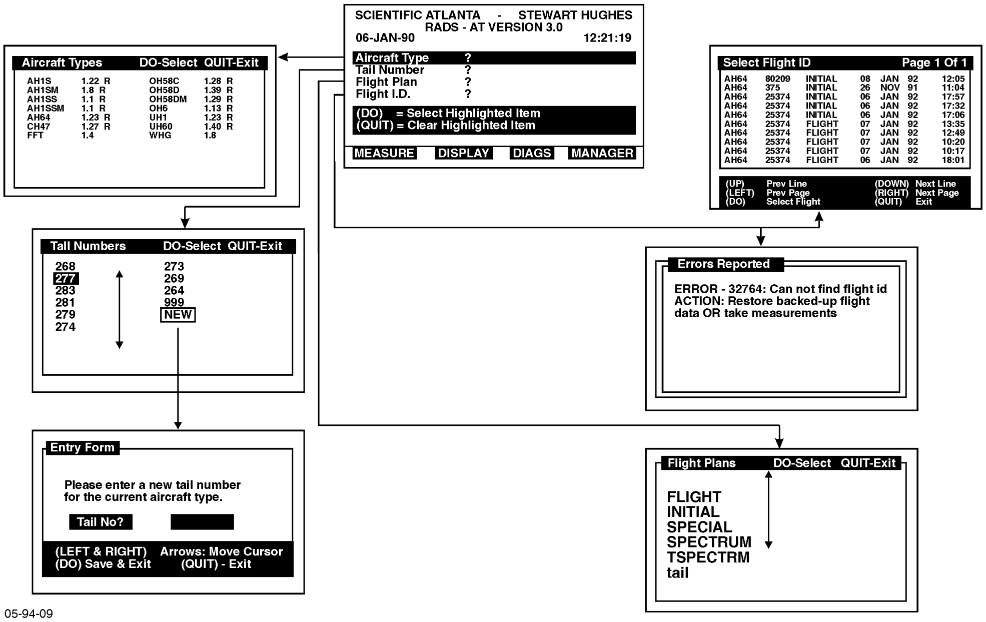
   b. One or more tip caps have been changed.

   c. One or more pitch control rods or rod end bearings have been changed.

   d. The main rotor blades have been removed and the hub has been disassembled.

C

MAIN OPERATIONS WINDOW



05-94-09

NOTES

2. Set up RADS-AT.

   a. Apply aircraft power via APU.

   b. Turn on the DAU.

   c. Turn on the CADU.

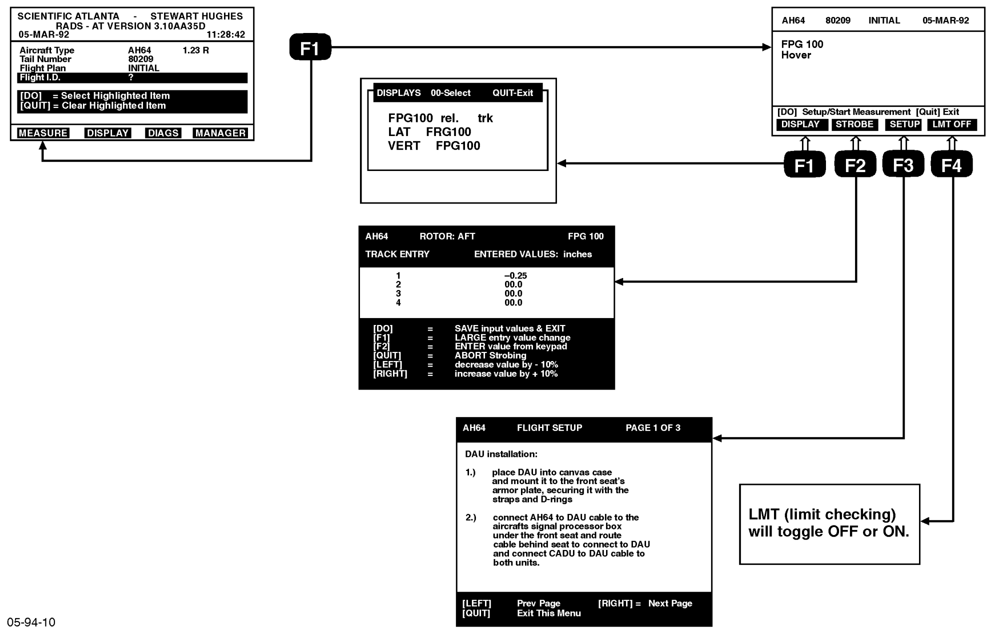
   d. Select AH-64 from TYPE menu and GROUND from FLT PLAN menu.

   e. Select proper tail number from previous selections in TAIL NO menu or enter a new tail number (up to seven digits).

   f. Select Initial from FLT Plan menu.

C

MEASURE CODE (F1)

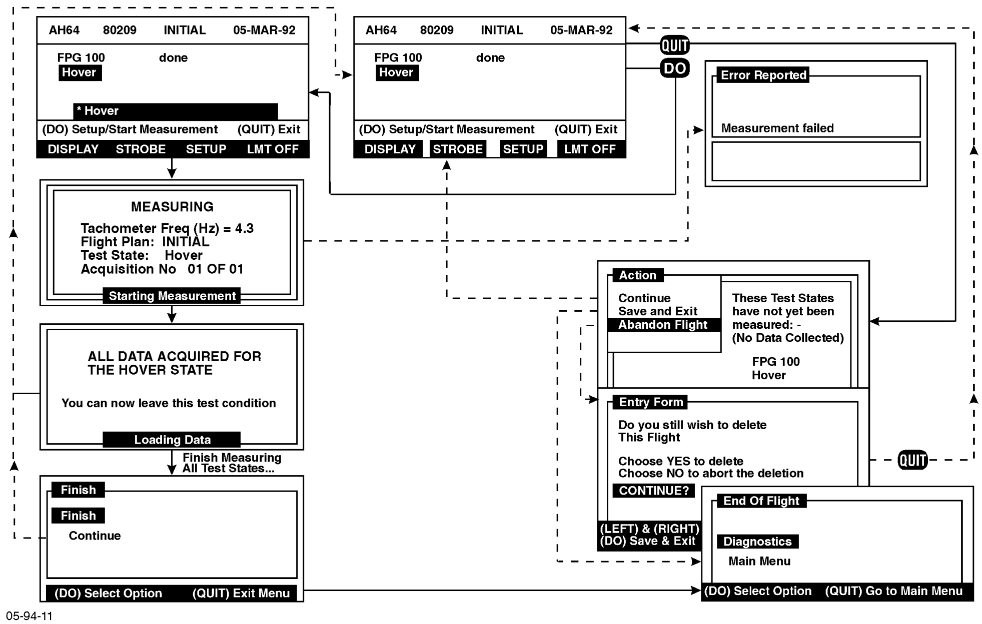


NOTES

g. Enter the measure code (F1) and verify FPG100 as the selection.

C

HOVER



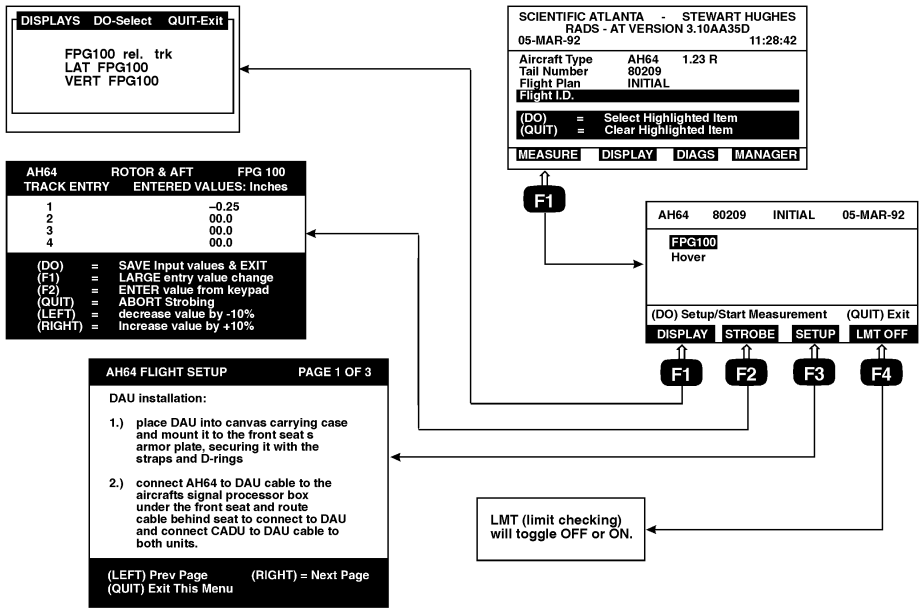
NOTES

h. Press DO when the pilot is stable at the highlighted selection.

i. Dual engine torque (a reference torque of 15% - 20% can be used). Reverify that the pilot is at the required test state and press DO again. The AVA will acquire track and vibration data. The screen will display **MEASURING** while the unit is acquiring data. When the track and vibration data is acquired the display will return to the selection display ready for the next measurement.

C

EVALUATE BLADE TRACK



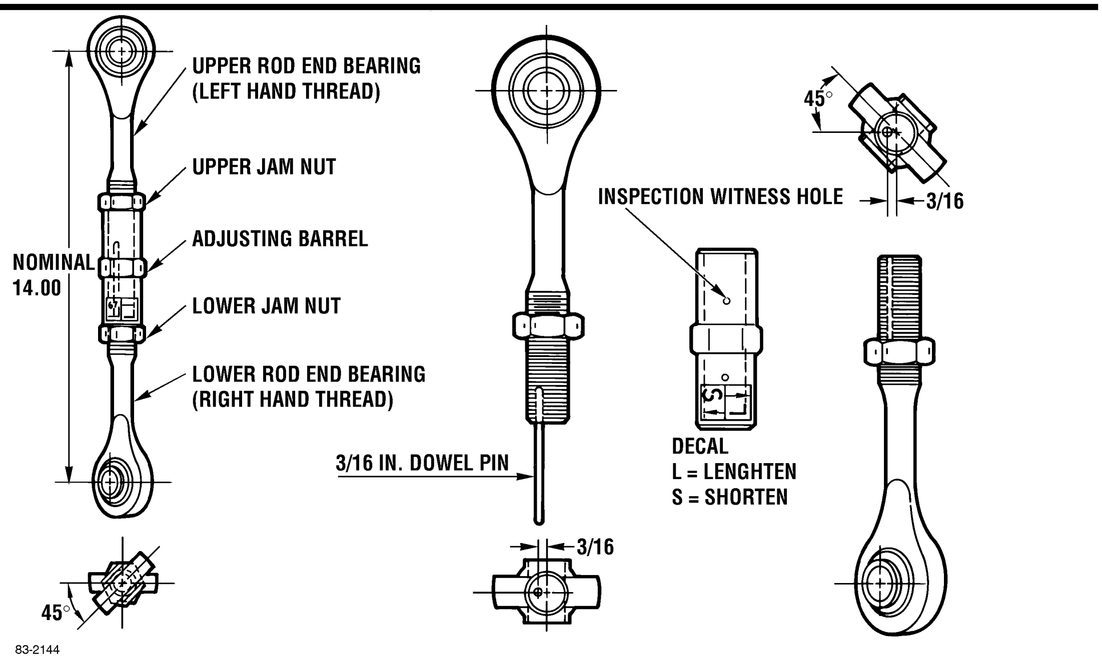
05-94-12

NOTES

j. At the completion of FPG100 press F1 for "Display" and press FPG100 "REL TRK" to evaluate blade track before proceeding.

C

PITCH LINK ASSEMBLY



NOTES

3. Pitch control (PC) link adjustments

   a. Mark barrel and upper rod end with a single vertical line for reference.

   b. Cut lockwire securing jam-nuts to barrel of PC link to be adjusted.

   c. Loosen upper jam-nut while holding barrel of PC link.

   d. Loosen lower jam-nut while holding barrel of PC link.

   e. To determine which way to turn barrels, grasp the PC link barrel with right hand, thumb pointing upwards.

   f. If the barrel is turned in the direction of the pointing fingers, the thumb indicates the direction of blade movement.

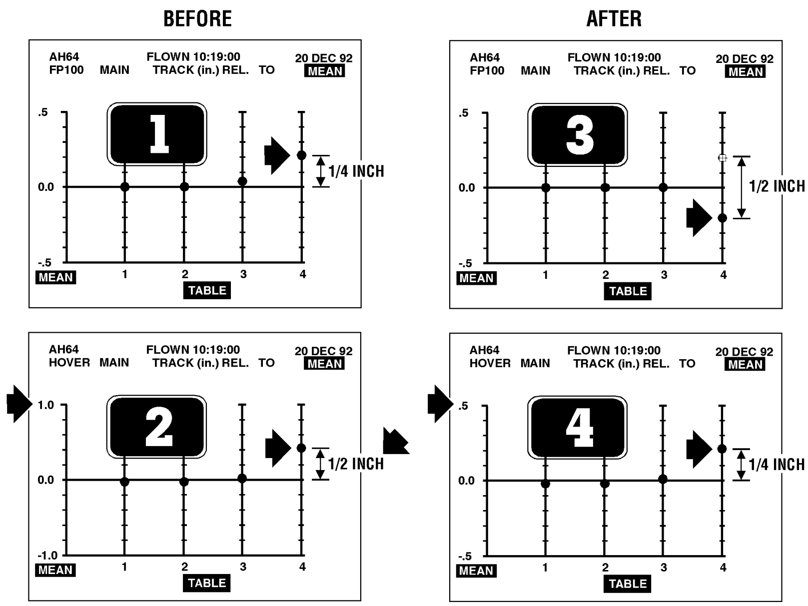
   g. Turn barrel the specified amount displayed on the AVA correction screen.

   h. Tighten jam-nuts and torque to 900 inch-pounds. Install lockwire.

   i. Re-check ground track and balance.

C

ADJUSTMENT OF PITCH CHANGE LINKS BEFORE FLIGHT



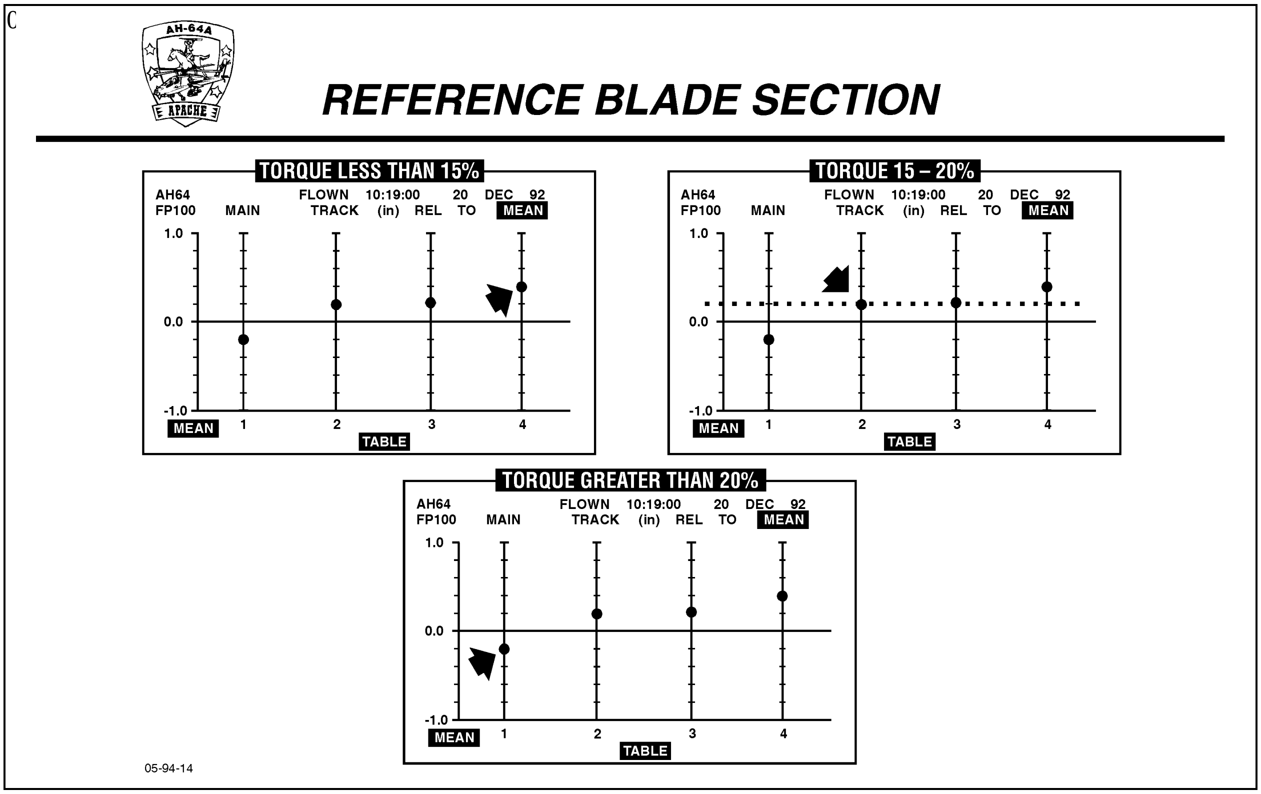
05-94-13

NOTES

4. Blade tip must be within a 1/4 inch or less of each other before proceeding to hover check.

    a. If track is greater than 1/4 inch, complete normal aircraft shut-down and make pitch link adjustments to bring blades within a track of 1/4 inch or less.

    b. The blades can be adjusted for ground track and reference torque.


C
AH-64A
APACHE
REFERENCE BLADE SECTION
TORQUE LESS THAN 15%
AH64 FLOWN 10:19:00 20 DEC 92
FP100 MAIN TRACK (in) REL TO MEAN
1.0
0.0
-1.0
MEAN 1 2 3 4
TABLE
TORQUE 15 – 20%
AH64 FLOWN 10:19:00 20 DEC 92
FP100 MAIN TRACK (in) REL TO MEAN
1.0
0.0
-1.0
MEAN 1 2 3 4
TABLE
TORQUE GREATER THAN 20%
AH64 FLOWN 10:19:00 20 DEC 92
FP100 MAIN TRACK (in) REL TO MEAN
1.0
0.0
-1.0
MEAN 1 2 3 4
TABLE
05-94-14

NOTES

5. Torque is not valid until autorotation check can be accomplished in accordance with the MTF. This is only a starting point for maintenance expedience.

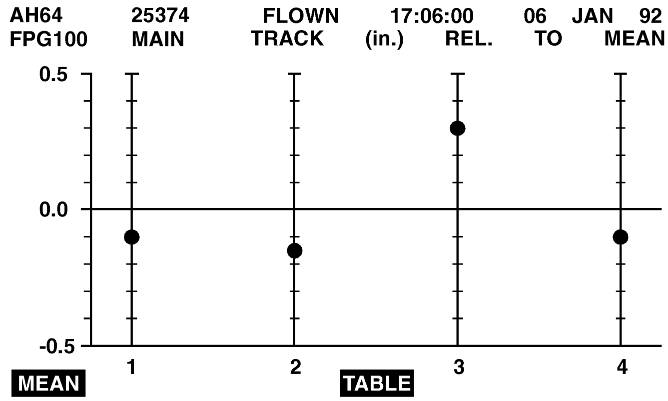
    a. Reference blade is selected by evaluating the dual flat pitch torque. If torque indication is less than 15%, select the highest blade as the reference blade and adjust other blades up to the reference blade accordingly.

    b. If torque is between 15% and 20%, select an imaginary center line between the blades on the track chart as the mean and adjust blades up or down accordingly.

    c. If the torque indication is greater than 20%, select lowest blade as the reference blade and adjust the blades accordingly.

C

BLADE TRACKING
GREATER THAN 1/4 INCH



AH64 25374 FLOWN 17:06:00 06 JAN 92
FPG100 MAIN (in.) REL. TO MEAN

BLADE	TRACK	LAG
1	-0.092	0.085
2	-0.141	-0.014
3	0.296	-0.040
4	-0.063	-0.031

05-94-15

NOTES

6. Continue blade adjustments until flat pitch is less than 1/4 inch.

C

BLADE TRACKING CORRECTIONS

– – – – – Blades – – – – –

1	2	3	4
+278.00	–217.00	0.00	0.00
+2ea –3	–1ea –3		
+1ea –5	–2ea –5		

Pitch Link (Flats)
+ means Increase length
– means Decrease length

– – – – – Blades – – – – –

1	2	3	4
0.00	+0.25	–0.75	0.00

05-94-16

NOTES

7. Blade tracking corrections to achieve less than 1/4 inch.

C

PHASING

AH-64	Flown 10:19:00			20 DEC 92
Lag	Main Track (in.) Rel to Mean			

	Lag			
Test	1	2	3	4
FP 100	0.08	-0.11	0.31	0.09
Hover	-0.38	-0.17	0.41	0.11

05-94-17

NOTES

8. Dynamic blade phasing and damper pre-load evaluation.

   a. "LAG TREND" reading at a hover decreased more than - .25 indicating the blade is lagging more than it should.

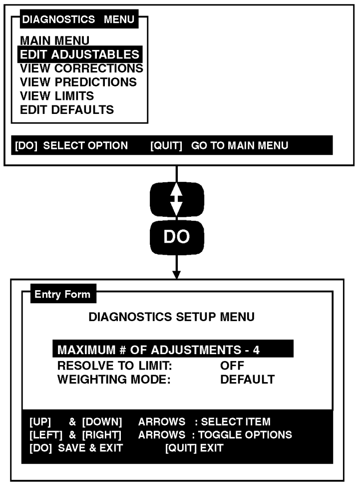
   b. To correct this condition adjustment is made to the leading edge damper only.

   c. Blade #3 is out of phase.

   d. To correct this condition the trailing edge damper must be shortened 1/2 turn and the leading edge damper lengthened 1/2 turn.

C

LIMITING CORRECTIONS AND EDITING ADJUSTABLES



— ENTER THE NUMBER OF DESIRED CORRECTIONS USING THE NUMBER KEYPAD

— REVIEW THE PREDICTED RESPONSE

AH64	80209 INITIAL	08 JAN 92		12:05
	1	2	3	4
Hub Weight	Y	Y	N	N
Pitch Link	Y	Y	Y	Y
Tab 8-10	N	N	N	N
Tab 6-10	N	N	N	N
Tab 4-10	N	N	N	N
Tab 1-10	Y	N	Y	N

TOGGLE CLRADJ CLRBLD DEFLTS

TOGGLE – Changes a single adjustment
CLRADJ – Changes all adjustments of the selected type to NO
CLRBLD – Changes all adjustments on a single blade to NO
DEFLTS – Changes all adjustments back to the default conditions

Y – Means adjustment type is included in correction calculation
N – Means it won't be included

05-94-18

NOTES

e. After the best possible track condition has been achieved from FPG100 to Hover, perform one additional FPG100 and Hover check to determine the main rotor balance.

f. Proceed to diagnostics

(1) Continue to press ENTER until the menu "EDIT ADJUSTABLES" appears and press ENTER.

(2) Turn all adjustments off except two selected blades for weight. (Your choice of blades, just do not pick two opposite blades i.e., blades one and three or two and four. Pick blades that are separated by ninety degrees).

(3) Press ENTER and wait for the results.

(4) Perform weight adjustment as necessary per diagnostics results.

g. Return to the AVA main menu and select flight plan "FLIGHT".

9. Track main rotor (in-flight)

a. Main rotor in-flight vertical tracking should be performed when any of the following occurs

(1) One per/rev in-flight vibration is unacceptable.

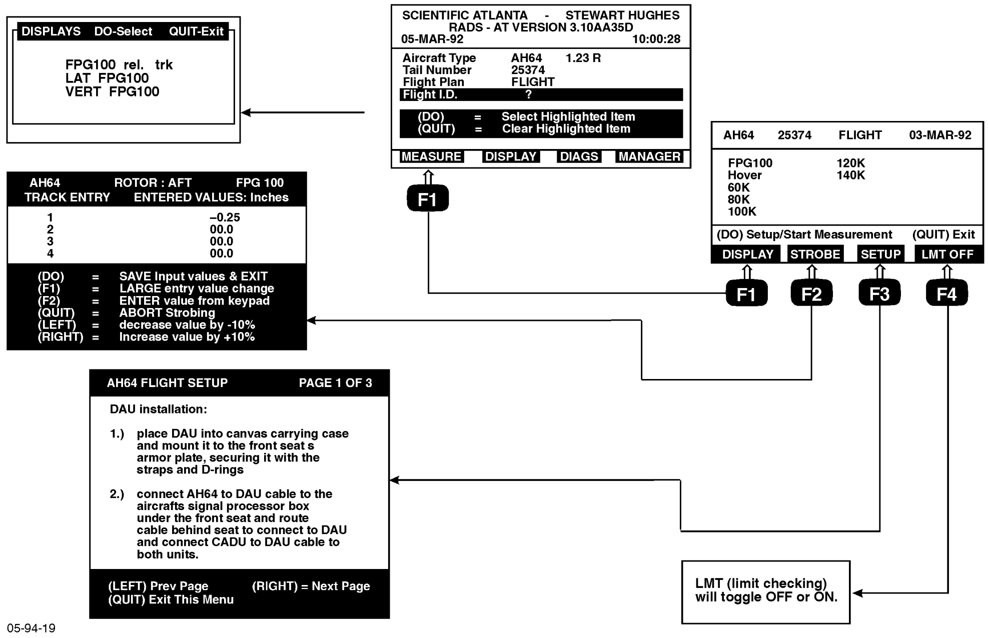
(2) Changes have been made to the track of one or more main rotor blades as a result of performing ground tracking adjustments.

b. Configure RADS-AT for in-flight measurements.

(1) Select AH-64 from TYPE menu and FLIGHT from FLT PLAN menu.

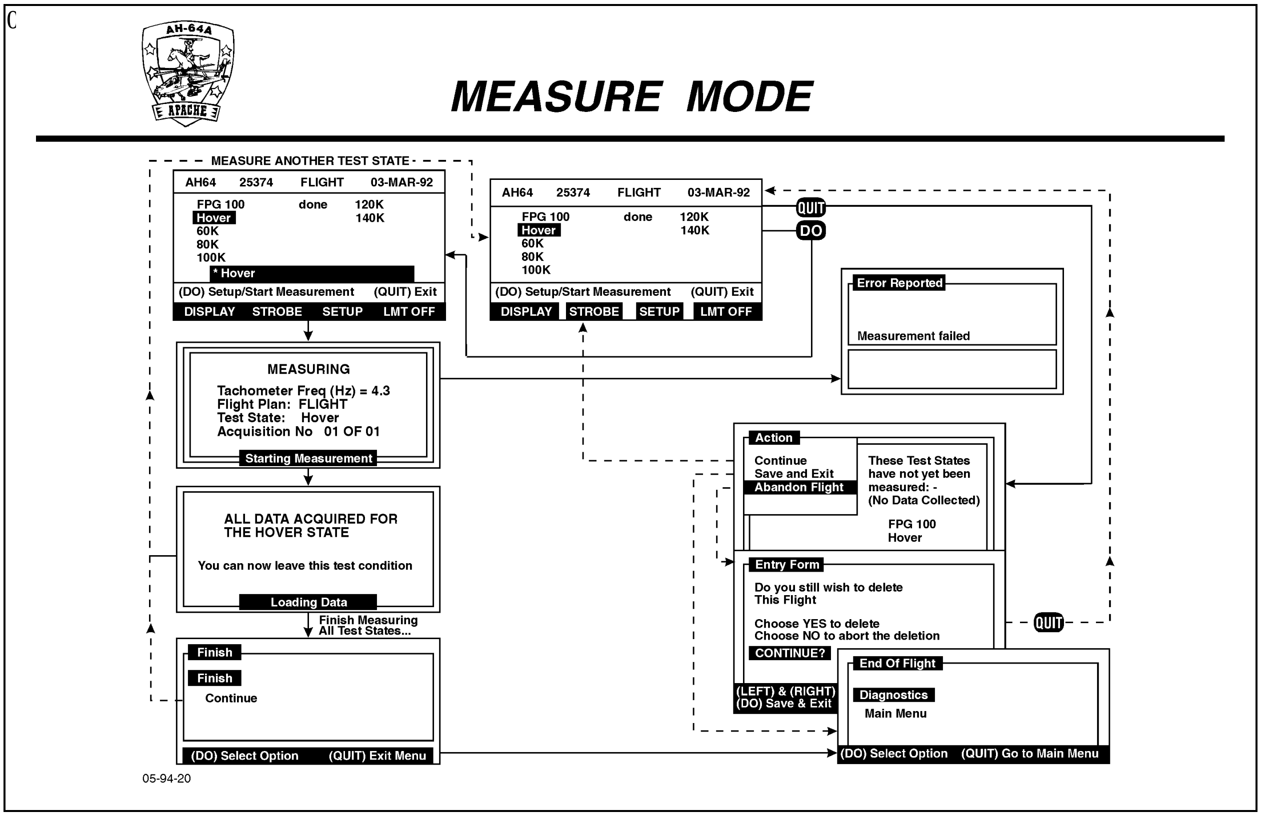
C

TAIL NUMBER



NOTES

(2) Enter the TAIL NO menu and select a previous tail number or enter a new one (up to seven digits).



C
AH-64A
APACHE
MEASURE MODE
MEASURE ANOTHER TEST STATE
AH64 25374 FLIGHT 03-MAR-92
FPG 100 done 120K
Hover 140K
60K
80K
100K
* Hover
(DO) Setup/Start Measurement (QUIT) Exit
DISPLAY STROBE SETUP LMT OFF
AH64 25374 FLIGHT 03-MAR-92
FPG 100 done 120K
Hover 140K
60K
80K
100K
(DO) Setup/Start Measurement (QUIT) Exit
DISPLAY STROBE SETUP LMT OFF
QUIT
DO
Error Reported
Measurement failed
MEASURING
Tachometer Freq (Hz) = 4.3
Flight Plan: FLIGHT
Test State: Hover
Acquisition No 01 OF 01
Starting Measurement
Action
Continue
Save and Exit
Abandon Flight
These Test States have not yet been measured: -
(No Data Collected)
FPG 100
Hover
ALL DATA ACQUIRED FOR THE HOVER STATE
You can now leave this test condition
Loading Data
Finish Measuring All Test States...
Entry Form
Do you still wish to delete This Flight
Choose YES to delete
Choose NO to abort the deletion
CONTINUE?
QUIT
(LEFT) & (RIGHT)
(DO) Save & Exit
End Of Flight
Diagnostics
Main Menu
(DO) Select Option (QUIT) Go to Main Menu
Finish
Finish
Continue
(DO) Select Option (QUIT) Exit Menu
05-94-20

NOTES

(3) Enter the MEASURE mode by pressing F1. Verify that FPG100 is selected.

(4) Press DO when the pilot has arrived at the next test state.

(5) Reverify that the pilot is at the required test state and press DO again.

(6) The AVA will acquire track and vibration data. The screen will display **MEASURING** while the unit is acquiring data. When the track and vibration data is acquired the display will return to the selection display ready for the next measurement.

WARNING

Do not exceed any airspeed at which excessive vibration is present. Excessive vibration may result in rotor blade delamination or distortion. Make track corrections prior to proceeding to a higher airspeed.

NOTE

Autorotation check should be done as soon as vibration levels allow. Any change in pitch link adjustments will affect the track for rotor smoothing.

(7) After the last measurement is completed, press DO on "finish", press DO on diagnostics.

(8) If the measurements are within specified limits, press QUIT to main menu.

(9) If measured values exceed specifications, press DO to enter the DIAGS mode.

C

AH-64 TEST STATES

AVA Test	Initial	Flight	Tail
FPG 100	100% NR, flat pitch	100% NR, flat pitch	
fpgti			Tail balance — flat pitch, 100% NR
HOVER	HOVER	Hover	
60 k		60 knots, level flight	
80 k		80 knots, level flight	
100 k		100 knots, level flight	
120 k		120 knots, level flight	
140 k		140 knots, level flight	
Special Test			
VH		VH level flight	
45 degrees		45 degrees at 110 knots	
ASYNC Test			
ASPLAT		ASYNC power spectrum LATERAL	
ASPVRT		ASYNC power spectrum VERTICAL	
ASPTL			Tail power spectrum
SFTCPR		ASYNC shaft driven compressor CH1	

05-94-21

NOTES

(10) The following test states apply for in-flight tracking of the AH-64.

(a) Hover

(b) 60 knots, level flight

(c) 80 knots, level flight

(d) 100 knots, level flight

(e) 120 knots, level flight

(f) 140 knots, level flight

C

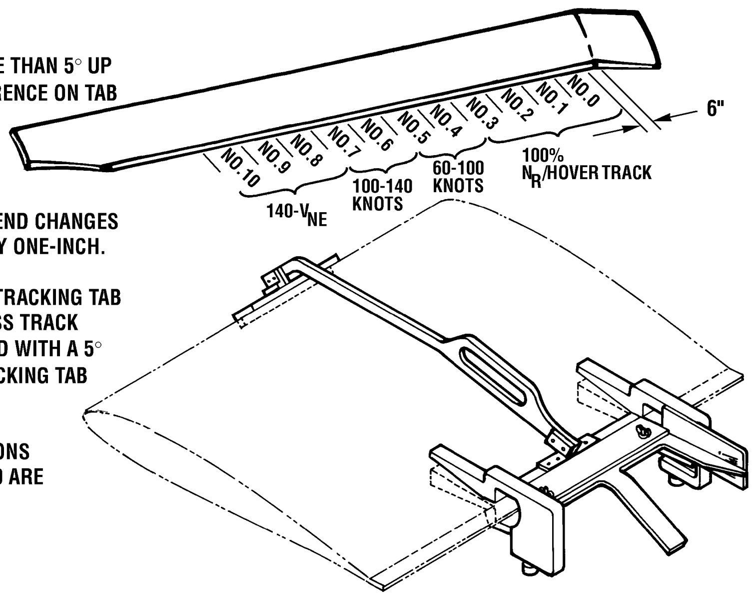
MAIN ROTOR TAB BENDING STATIONS

CAUTION

DO NOT BEND A TAB MORE THAN 5° UP OR DOWN FROM 0° REFERENCE ON TAB BENDING TOOL.

NOTES:

1. ONE DEGREE OF TAB BEND CHANGES TRACK APPROXIMATELY ONE-INCH.
2. DO NOT USE GROUND TRACKING TAB LOCATION NO. 0 UNLESS TRACK CANNOT BE CORRECTED WITH A 5° BEND AT GROUND TRACKING TAB LOCATION NO. 1.
3. TAB TRACKING LOCATIONS NO. 0 THROUGH NO. 10 ARE 10 INCHES IN LENGTH.



BLADE TAB BENDING TOOL

05-94-22
05-91-12

NOTES

10. Main rotor tab adjustment

a. The main rotor blade has eleven stations (pockets 0 through 10) starting with zero station, 6 inches inboard of electrostatic discharger. Each station is 10 inches in length.

b. Maximum allowable tab edge bend is 5 degrees, do not bend tab more than 5 degrees from 0 degree position on tab bending tool. Make two 1 degree bends in adjacent stations rather than one 2 degree bend in one station.

(1) Station number 0 through 3 is used for hover track.

(2) Station number 4 through 10 is for in-flight track of 60 - VNE knots.

c. Tab bend corrections called out on the diagnostics display will refer to the start of a continuous bend.

Example: If the display recommends 1 degree up at pocket 4/10, the bend should start at pocket 4 and continue through pocket 10.

d. Fly the aircraft and recheck the 1/REV vibrations through the required flight conditions.

11. Tab bending

CAUTION

** Place tab adjustment tool in the center of the tab bend pocket which is to be bent. Tab tracking locations (#0 through #10) are 10 inches in length, starting six inches inboard of swept tip. Do not bend inboard pocket #10.

** Do not make bends in opposite direction in adjacent pockets. It is preferable to remove an upward bend (reset to Zero degrees) if the adjacent pocket requires a downward bend.

** Any noticeable deformity (kinks or sharp edges caused by the tab bending tool) is cause for rejection of the blade.

** It is preferable to make two 1 degree bends in adjacent stations rather than a 2 degree bend in one station.

** Maximum tabbing should not exceed five (5) degrees to prevent tab damage and/or tab wash-out with increasing aircraft flight hours.

C

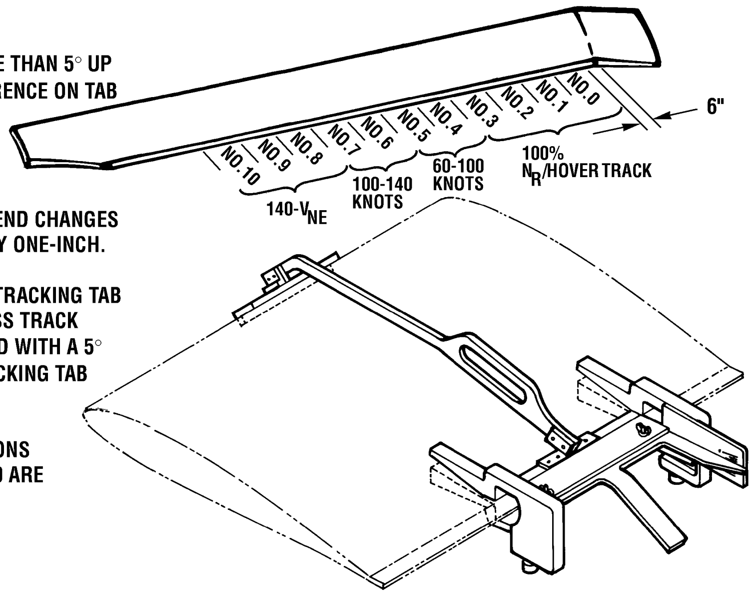
MAIN ROTOR TAB BENDING STATIONS

CAUTION

DO NOT BEND A TAB MORE THAN 5° UP OR DOWN FROM 0° REFERENCE ON TAB BENDING TOOL.

NOTES:

1. ONE DEGREE OF TAB BEND CHANGES TRACK APPROXIMATELY ONE-INCH.
2. DO NOT USE GROUND TRACKING TAB LOCATION NO. 0 UNLESS TRACK CANNOT BE CORRECTED WITH A 5° BEND AT GROUND TRACKING TAB LOCATION NO. 1.
3. TAB TRACKING LOCATIONS NO. 0 THROUGH NO. 10 ARE 10 INCHES IN LENGTH.



BLADE TAB BENDING TOOL

05-94-22
05-91-12

NOTES

a. Do not bend the trim tab outboard of station zero. Area is very sensitive for tracking.

b. Avoid bending tap between stations 0 and 3 unless absolutely necessary.

c. Do not bend tab inboard of station 10.

d. Install tab bending tool on blade at outboard edge of tab station to be adjusted. A reference mark on blade indicates station.

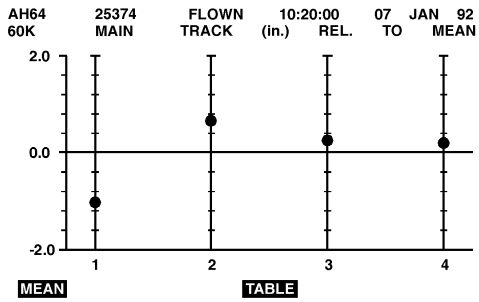
e. To raise blade, bend tab up. To lower blade, bend tab down.

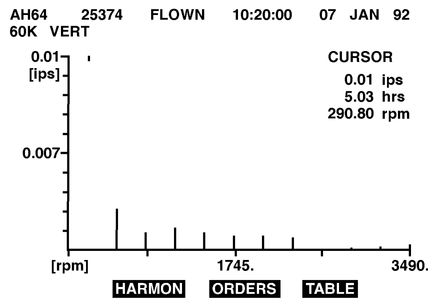
f. One degree of bend on tab will change blade track 1/2 to 1 inch. On first change bend tab one degree and observe track change. Calculate all other tab adjustments for that blade from results.

g. Keep tab bends to a minimum. Bend tabs as far inboard as practical for airspeed at which track is being corrected.

C

AH-64A SPECIAL TESTS





AH64 25374 FLOWN 10:20:00 07 JAN 92
60K MAIN (in.) REL. TO MEAN

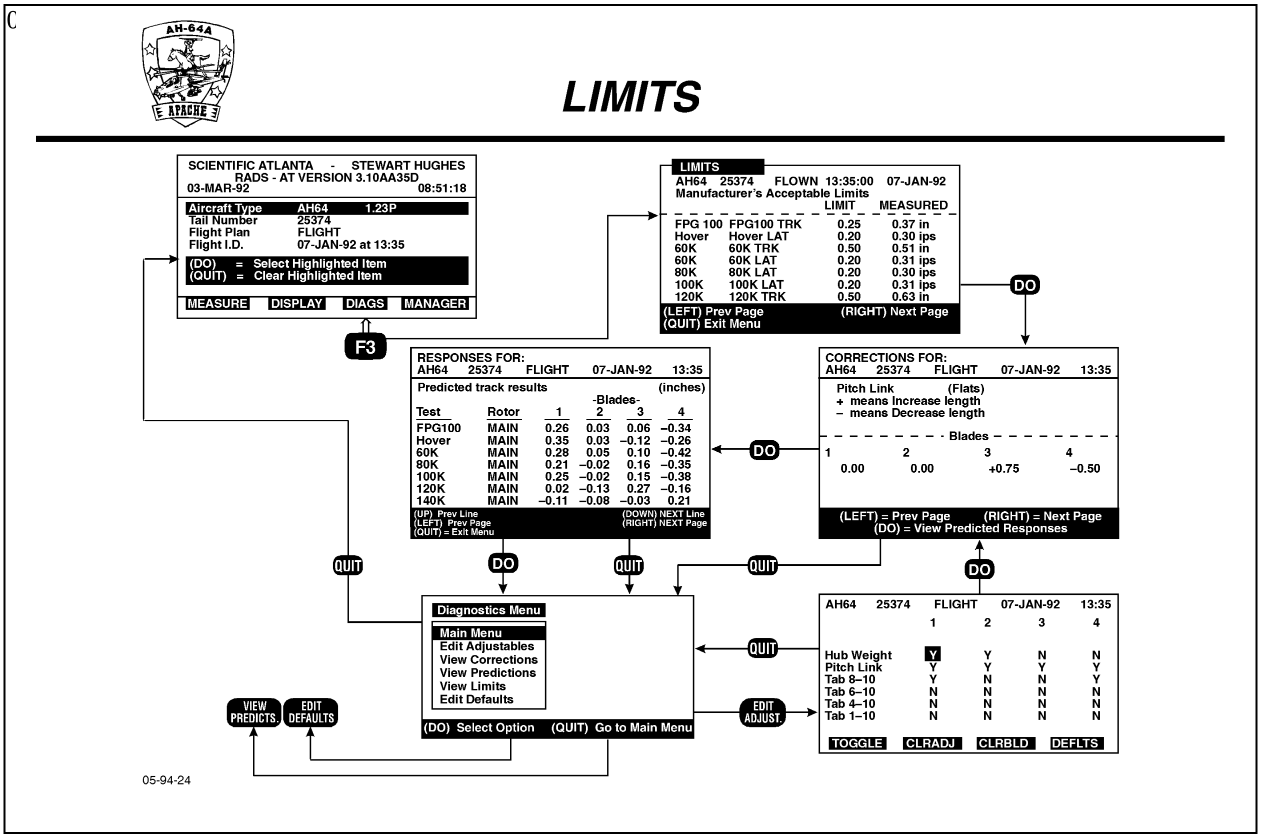
BLADE	TRACK	LAG
1	-1.048	0.086
2	0.637	-0.242
3	0.252	0.168
4	0.159	-0.012

05-94-23

NOTES

12. Special tests

    a. VH level flight



C
AH-64A
APACHE
LIMITS
SCIENTIFIC ATLANTA - STEWART HUGHES
RADS - AT VERSION 3.10AA35D
03-MAR-92 08:51:18
Aircraft Type AH64 1.23P
Tail Number 25374
Flight Plan FLIGHT
Flight I.D. 07-JAN-92 at 13:35
(DO) = Select Highlighted Item
(QUIT) = Clear Highlighted Item
MEASURE DISPLAY DIAGS MANAGER
F3
LIMITS
AH64 25374 FLOWN 13:35:00 07-JAN-92
Manufacturer's Acceptable Limits
LIMIT MEASURED
FPG 100 FPG100 TRK 0.25 0.37 in
Hover Hover LAT 0.20 0.30 ips
60K 60K TRK 0.50 0.51 in
60K 60K LAT 0.20 0.31 ips
80K 80K LAT 0.20 0.30 ips
100K 100K LAT 0.20 0.31 ips
120K 120K TRK 0.50 0.63 in
(LEFT) Prev Page (RIGHT) Next Page
(QUIT) Exit Menu
DO
RESPONSES FOR:
AH64 25374 FLIGHT 07-JAN-92 13:35
Predicted track results (inches)
-Blades-
Test Rotor 1 2 3 4
FPG100 MAIN 0.26 0.03 0.06 –0.34
Hover MAIN 0.35 0.03 –0.12 –0.26
60K MAIN 0.28 0.05 0.10 –0.42
80K MAIN 0.21 –0.02 0.16 –0.35
100K MAIN 0.25 –0.02 0.15 –0.38
120K MAIN 0.02 –0.13 0.27 –0.16
140K MAIN –0.11 –0.08 –0.03 0.21
(UP) Prev Line (DOWN) NEXT Line
(LEFT) Prev Page (RIGHT) NEXT Page
(QUIT) = Exit Menu
CORRECTIONS FOR:
AH64 25374 FLIGHT 07-JAN-92 13:35
Pitch Link (Flats)
+ means Increase length
– means Decrease length
Blades
1 2 3 4
0.00 0.00 +0.75 –0.50
(LEFT) = Prev Page (RIGHT) = Next Page
(DO) = View Predicted Responses
DO
QUIT
DO
QUIT
QUIT
DO
Diagnostics Menu
Main Menu
Edit Adjustables
View Corrections
View Predictions
View Limits
Edit Defaults
(DO) Select Option (QUIT) Go to Main Menu
QUIT
AH64 25374 FLIGHT 07-JAN-92 13:35
1 2 3 4
Hub Weight Y Y N N
Pitch Link Y Y Y Y
Tab 8–10 Y N N Y
Tab 6–10 N N N N
Tab 4–10 N N N N
Tab 1–10 N N N N
TOGGLE CLRADJ CLRBLD DEFLTS
VIEW PREDICTS.
EDIT DEFAULTS
EDIT ADJUST.
05-94-24

NOTES

13. Select LIMITS display and review results.

(

LIMIT CORRECTIONS

05-94-25

Corrections for:
AH64 25374 Flight 07 Jan 92 10:20

Hub weight (grams)
+ means add weight
- means remove weight

Blades			
1	2	3	4
+278.00	+1.25	0.00	0.00
+2ea -3	+1ea -5		
+1ea -5			

Pitch link (flats)
+ means increase length
- means decrease length

Blades			
1	2	3	4
+1.25	+1.25	-0.75	0.00

Tab 6-10 (degrees)
+ means bend tab up
- means bend tab down

Blades			
1	2	3	4
0.00	-1.50	0.00	-0.50

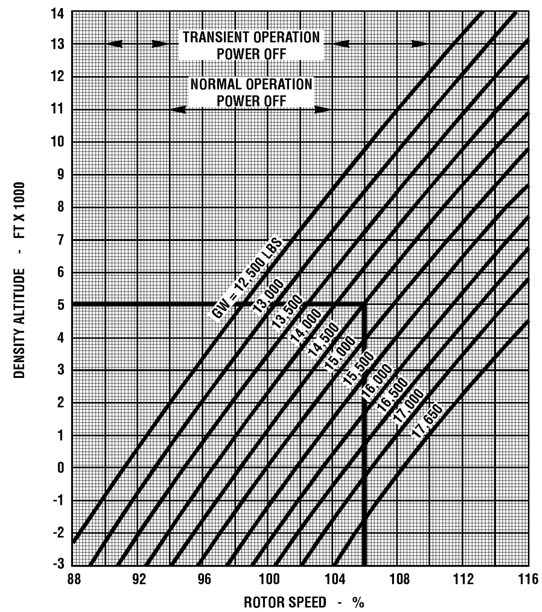
Tab 4-10 (degrees)
+ means bend tab up
- means bend tab down

Blades			
1	2	3	4
+0.50	0.00	+0.50	0.00

NOTES

a. If tach split is greater than 0.5 inches or vibrations are greater than 0.3 ips, select DIAGS from main menu and perform corrections specified.

MAIN ROTOR AUTOROTATION RPM CHART



EXAMPLE;
DENSITY ALTITUDE OF 5,000 FEET AT GROSS WEIGHT OF 14,500 LBS. RESULTS IN A ROTOR SPEED OF 106%

05-91-16

NOTES

D. Main rotor autorotation RPM check and adjustment

1. The purpose of the autorotation RPM check is to ensure that main rotor autorotational RPM is correct for aircraft and environmental conditions.

2. Autorotation RPM check description

a. The Pilot will perform an autorotation at approximately 80 KIAS, record RPM (N_R) and the following information:

PA	Fuel Wt
OAT	A/C Wt
DA	RPM (N_R)

b. Determine minimum main rotor RPM from Autorotation RPM Chart.

(1) The gross weight selected for the test in step (a) should be such as to produce an RPM within the normal operation limits of the Autorotation RPM Chart

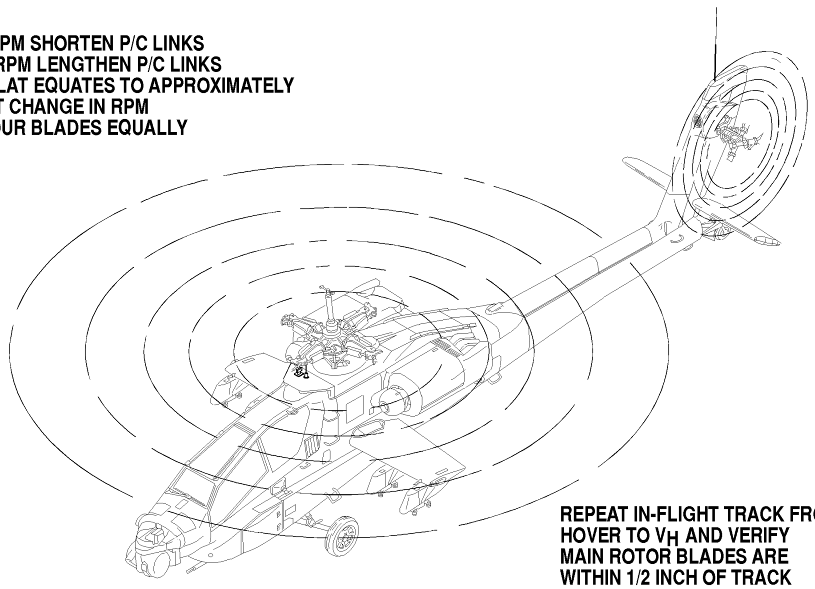
(2) The autorotation RPM established in step (a) must be equal to or up to 3 percent greater than the main rotor RPM determined from Autorotation RPM Chart.

(3) If the actual RPM is lower than the limits of the Autorotation RPM Chart, or more than 3 percent above the limits, the rotor blade pitch must be adjusted.

C

MAIN ROTOR AUTOROTATION RPM ADJUSTMENT

TO INCREASE RPM SHORTEN P/C LINKS
TO DECREASE RPM LENGTHEN P/C LINKS
ONE P/C LINK FLAT EQUATES TO APPROXIMATELY
2 TO 3 PERCENT CHANGE IN RPM
ADJUST ALL FOUR BLADES EQUALLY



REPEAT IN-FLIGHT TRACK FROM
HOVER TO V_H AND VERIFY
MAIN ROTOR BLADES ARE
WITHIN 1/2 INCH OF TRACK

05-92-11

NOTES

3. Autorotation RPM adjustment

   a. To increase RPM, the blade pitch must be reduced by shortening the pitch links.

   b. To decrease RPM, the blade pitch must be increased by lengthening the pitch links.

      (1) All four blades must be adjusted equally.

   c. Pitch link adjustments are very sensitive.

   d. Adjusting pitch link 1 flat equates to approximately 2 to 3 percent change in RPM.

   e. Repeat the steps above until autorotation RPM is within specifications of Autorotation RPM Chart.

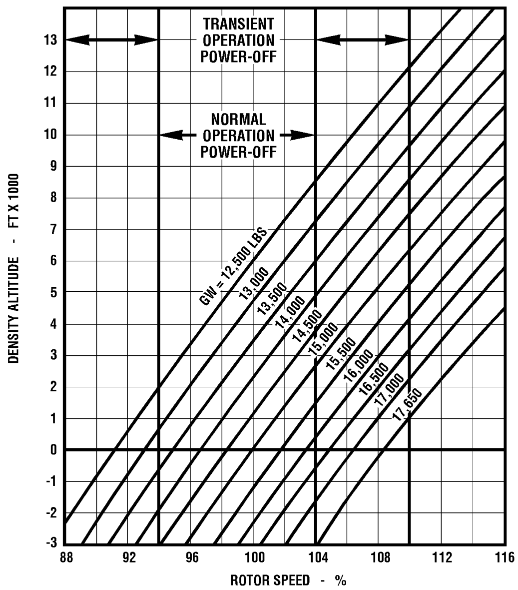
   f. Repeat in-flight track from hover to VH and verify that main rotor blades are within 1/2 inch of track. If not, repeat main rotor forward flight track and balance procedure.

   g. Remove track and balance accessories.

   h. Remove tip targets in the reverse procedure and stow in container.

C

AUTOROTATION ROTOR SPEED-COLLECTIVE FULL DOWN-100% NR = 289 RPM



05-94-26

TM 55-1520-238-MTF

AUTOROTATION ROTOR SPEED
COLLECTIVE FULL DOWN
100% NR = 289 RPM

GW - Subtract fuel consumed from takeoff gross weight.
DA - Complete using figure 5-7.
Nr - Must be within a range of -0 to +3.
Example: DA=0, GW=15000 lbs, RPM=100%.
Allowable range would be 100% to 103% RPM.

Figure 5-5. Autorotation RPM Chart.

5-8.3/ (5-8.4 blank) C 4

NOTES

(1) Perform limited test flight, including autorotational RPM check per TM 55-1520-238-MTF.

(a) Check autorotation RPM

1) Perform autorotation at 80 knots (TM 55-1520-238-MTF)

2) Record the following information

a) Pressure altitude

b) Outside air temperature (stabilize for one minute)

c) Fuel weight

d) Helicopter weight

e) Rotor RPM (**N_R**)

f) Density altitude

3) Determine minimum **N_R**, from autorotational RPM chart (TM 55-1520-238-MTF), for recorded conditions.

NOTE

Autorotational RPM must be equal to or not more than 3% greater than N_R determined from chart in TM 55-1520-238-MTF.

4) Land and shut down helicopter (TM 55-1520-238-MTF).

(b) Adjust autorotational RPM

NOTE

All four pitch links must be adjusted the same amount. Adjusting all four pitch links one flat will change N_R approximately 1.2 to 1.5 percent.

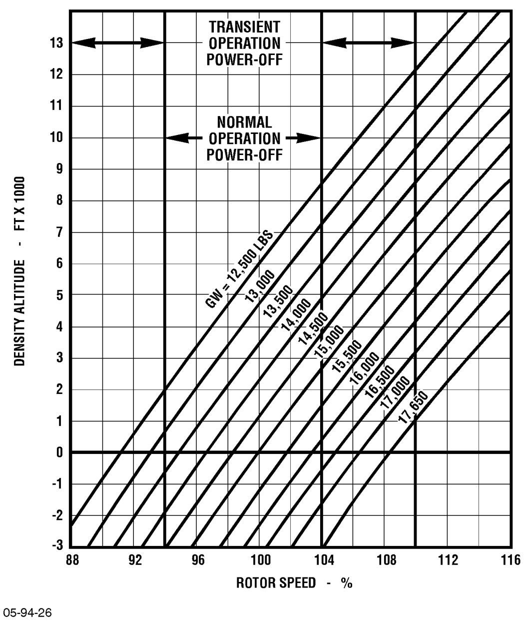
1) Shorten pitch links as indicated by chart to increase **N_R**. Adjust pitch links (para 5-10).

2) Lengthen pitch links as indicated by chart to decrease **N_R**. Adjust pitch links (para 5-10).

3) Inspect (TI).

C

AUTOROTATION ROTOR SPEED-
COLLECTIVE FULL DOWN-
100% NR = 289 RPM



TM 55-1520-238-MTF

AUTOROTATION ROTOR SPEED
COLLECTIVE FULL DOWN
100% NR = 289 RPM

GW - Subtract fuel consumed from takeoff gross weight.
DA - Complete using figure 5-7.
Nr - Must be within a range of -0 to +3.
Example: DA=0, GW=15000 lbs, RPM=100%.
Allowable range would be 100% to 103% RPM.

Figure 5-5. Autorotation RPM Chart.

5-8.3/ (5-8.4 blank) C 4

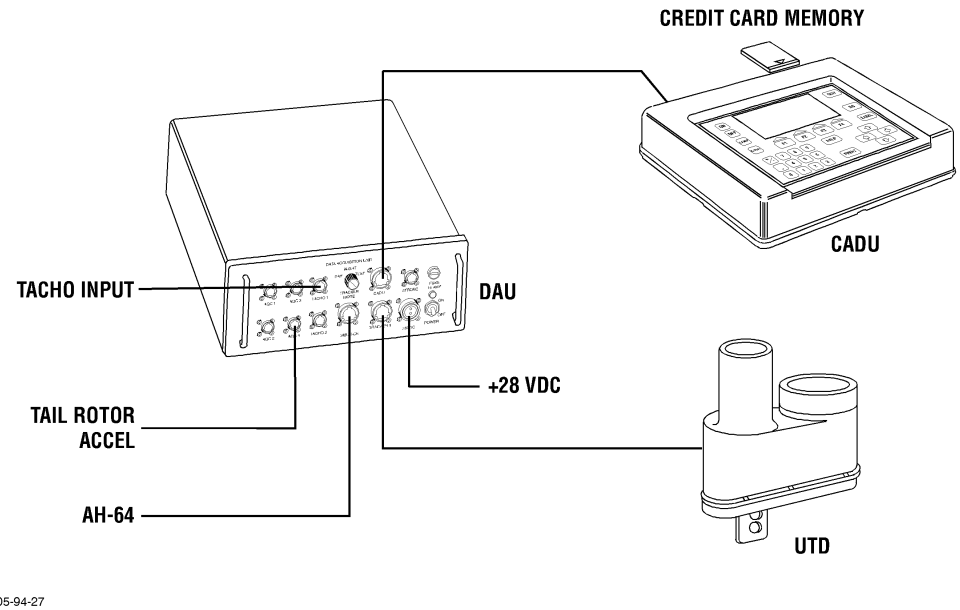
NOTES

4) Verify track and balance have not changed (para 5-10).

4. Remove track and balance equipment.

C

TYPICAL TEST SETUP CONFIGURATION



NOTES

E. Tail rotor balance using RADS-AT

1. Tail rotor test setup

a. Remove RADS-AT equipment from carrying case.

b. Ensure DAU is installed in canvas carrying case.

c. Using the long straps and D-rings, mount DAU to the outboard side of the co-pilot's left armor plate with connectors facing forward.

d. Connect breakout cable to signal processing box located beneath and to the right of the co-pilots seat.

e. Route the breakout cable behind the co-pilot's seat and around to the DAU.

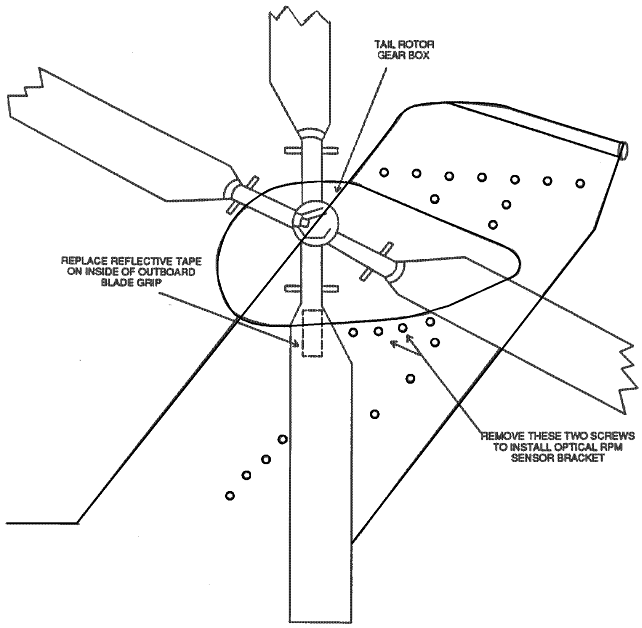
f. Connect the breakout cable to the receptacles on the DAU marked +28 VDC.

g. Connect the 10-ft CADU to DAU cable to both units.

h. Turn on the DAU.

C

INSTALL OPTICAL RPM SENSOR



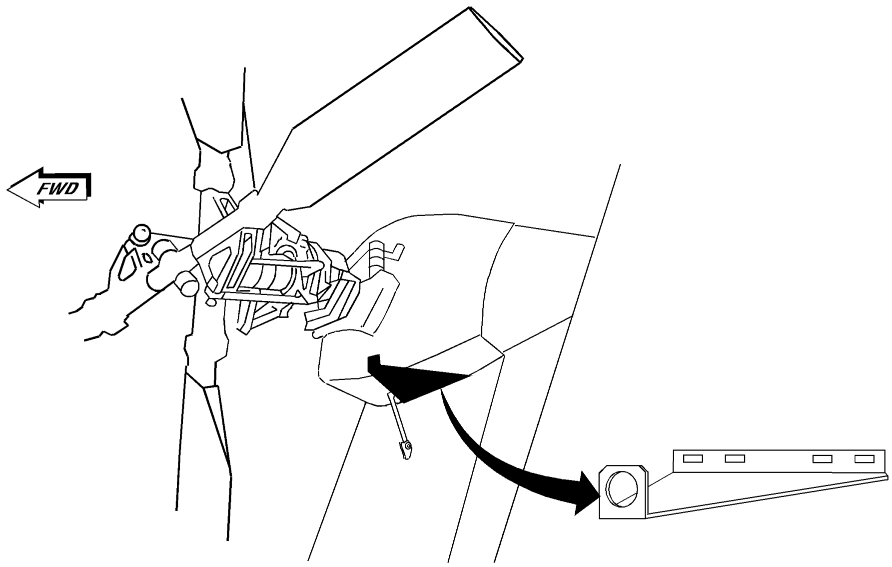
NOTES

2. Install optical RPM sensor.

   a. Remove the two airframe screws located on the bottom and center on the tail rotor gearbox airframe panel.

(

MOUNTING OPTICAL SENSOR



05-94-29

NOTES

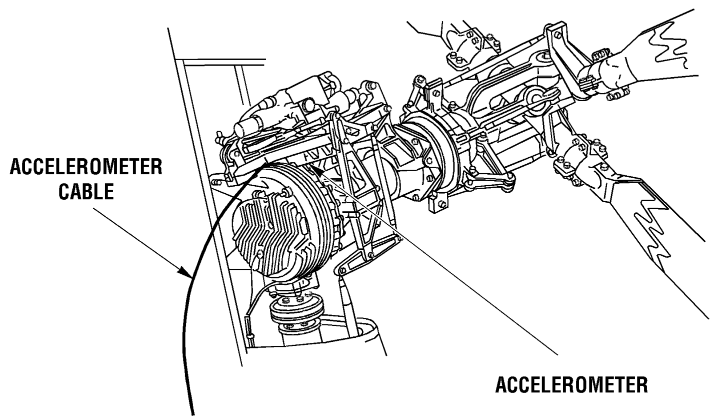
b. Install sensor bracket on tail with arrow on the bracket facing aft, and secure with airframe screws.

c. Place 4-inch strip of reflective tape on either outboard blade, aligning the tape with the approximate location of the 5 degree beam of the sensor. (Tape should be placed with the span of the blade.)

d. The blade with the reflective tape will be referred to in the RADS-AT diagnostics as the #1 outboard blade, the others being addressed as #1 inboard, and #2 outboard and inboard, following the direction of rotation.

C

INSTALL TAIL ROTOR ACCELEROMETER



TAIL ROTOR ACCELEROMETER INSTALLATION

05-94-30

NOTES

3. Install tail accelerometer

   a. Open access door at the top of the tail rotor gearbox cover, exposing the gearbox.

   b. Remove the topmost nut on gearbox, and install the accelerometer bracket. Ensure that bracket is oriented so that the accelerometer will be vertical with the cable connector facing up.

   c. Secure bracket with gearbox nut, and tighten nut.

   d. Install accelerometer on the bracket.

   e. Connect the accelerometer cable to the accelerometer and route down the tail and, with the optical sensor, forward to the DAU.

   f. Connect the accelerometer cable to DAU receptacle marked ACC4

   g. Connect optical sensor to DAU receptacle marked TACHO1.

F. Tail rotor balance

1. Operate helicopter at 100% N_R, flat pitch.

2. Turn on DAU.

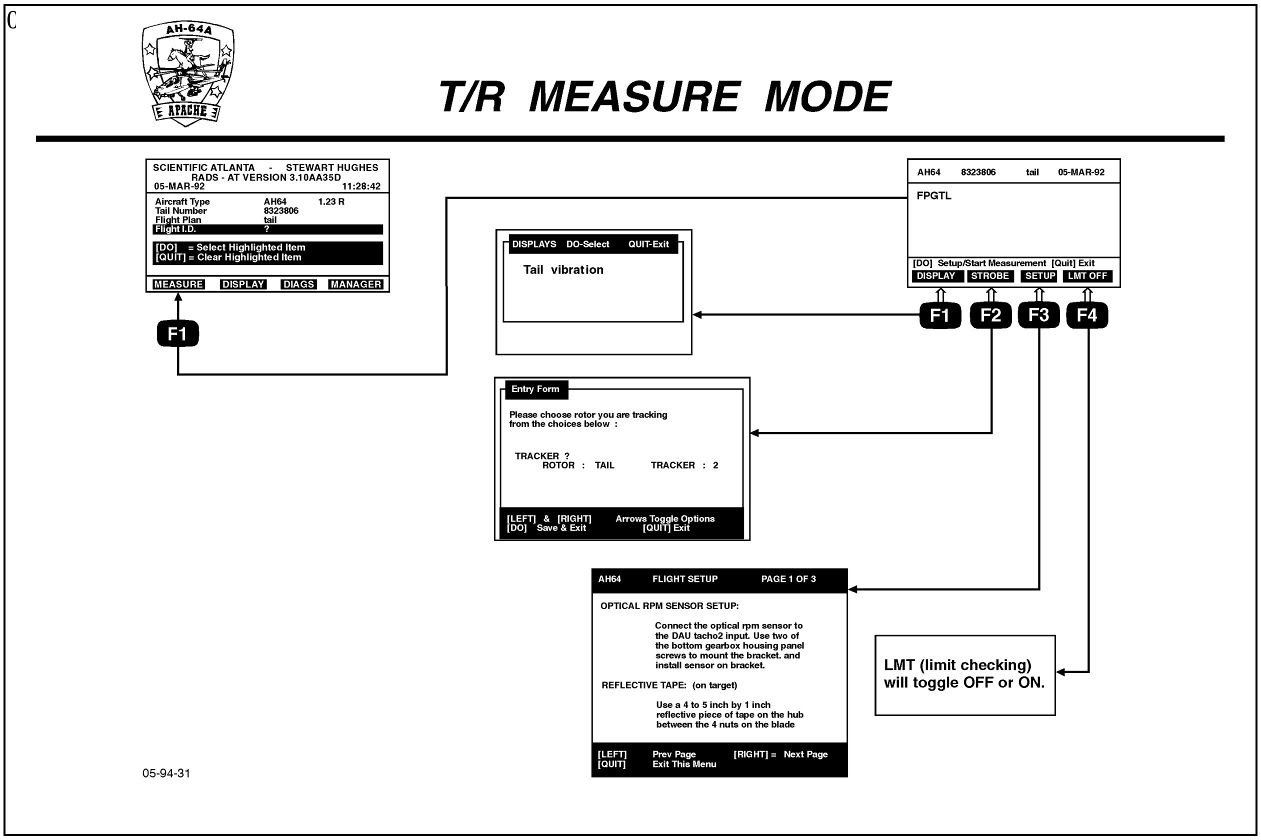
3. Turn on CADU.

4. Press QUIT on the CADU until all selections show Undefined.

5. Select AH-64 from the AIRCRAFT TYPE menu.

6. Enter the TAIL NO menu and select a previous tail number or enter a new one (up to seven digits).

7. Enter the FLIGHT PLAN menu and select TAIL.

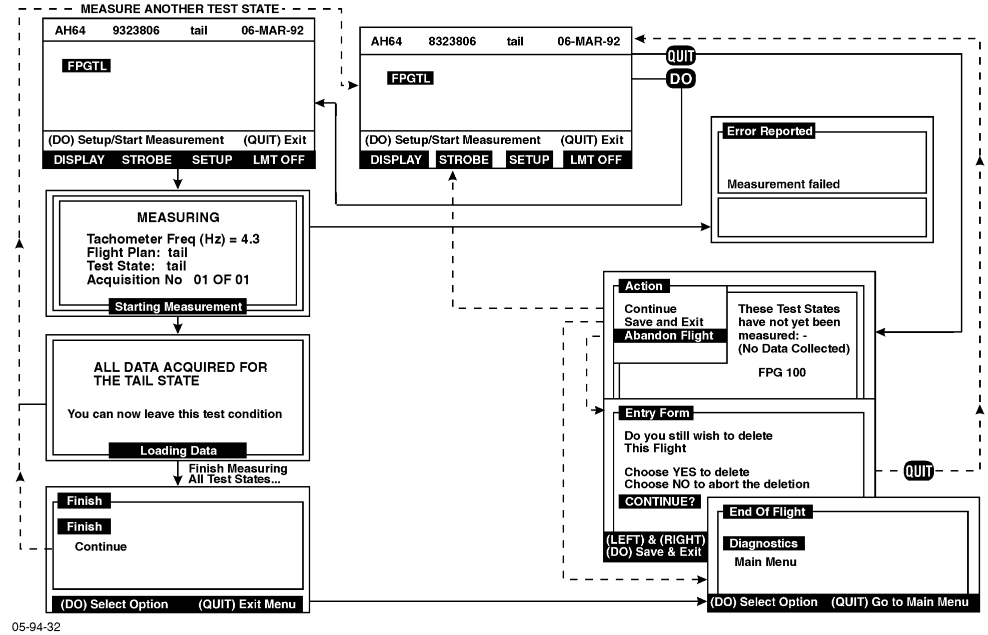

AH-64A
APACHE
T/R MEASURE MODE
SCIENTIFIC ATLANTA - STEWART HUGHES
RADS - AT VERSION 3.10AA35D
05-MAR-92 11:28:42
Aircraft Type AH64 1.23 R
Tail Number 8323806
Flight Plan tail
Flight I.D. ?
[DO] = Select Highlighted Item
[QUIT] = Clear Highlighted Item
MEASURE DISPLAY DIAGS MANAGER
F1
DISPLAYS DO-Select QUIT-Exit
Tail vibration
AH64 8323806 tail 05-MAR-92
FPGTL
[DO] Setup/Start Measurement [Quit] Exit
DISPLAY STROBE SETUP LMT OFF
F1 F2 F3 F4
Entry Form
Please choose rotor you are tracking
from the choices below :
TRACKER ?
ROTOR : TAIL TRACKER : 2
[LEFT] & [RIGHT] Arrows Toggle Options
[DO] Save & Exit [QUIT] Exit
AH64 FLIGHT SETUP PAGE 1 OF 3
OPTICAL RPM SENSOR SETUP:
Connect the optical rpm sensor to the DAU tacho2 input. Use two of the bottom gearbox housing panel screws to mount the bracket. and install sensor on bracket.
REFLECTIVE TAPE: (on target)
Use a 4 to 5 inch by 1 inch reflective piece of tape on the hub between the 4 nuts on the blade
[LEFT] Prev Page [RIGHT] = Next Page
[QUIT] Exit This Menu
LMT (limit checking) will toggle OFF or ON.
05-94-31

NOTES

8. Enter the MEASURE mode and verify FPGTL as the selection.

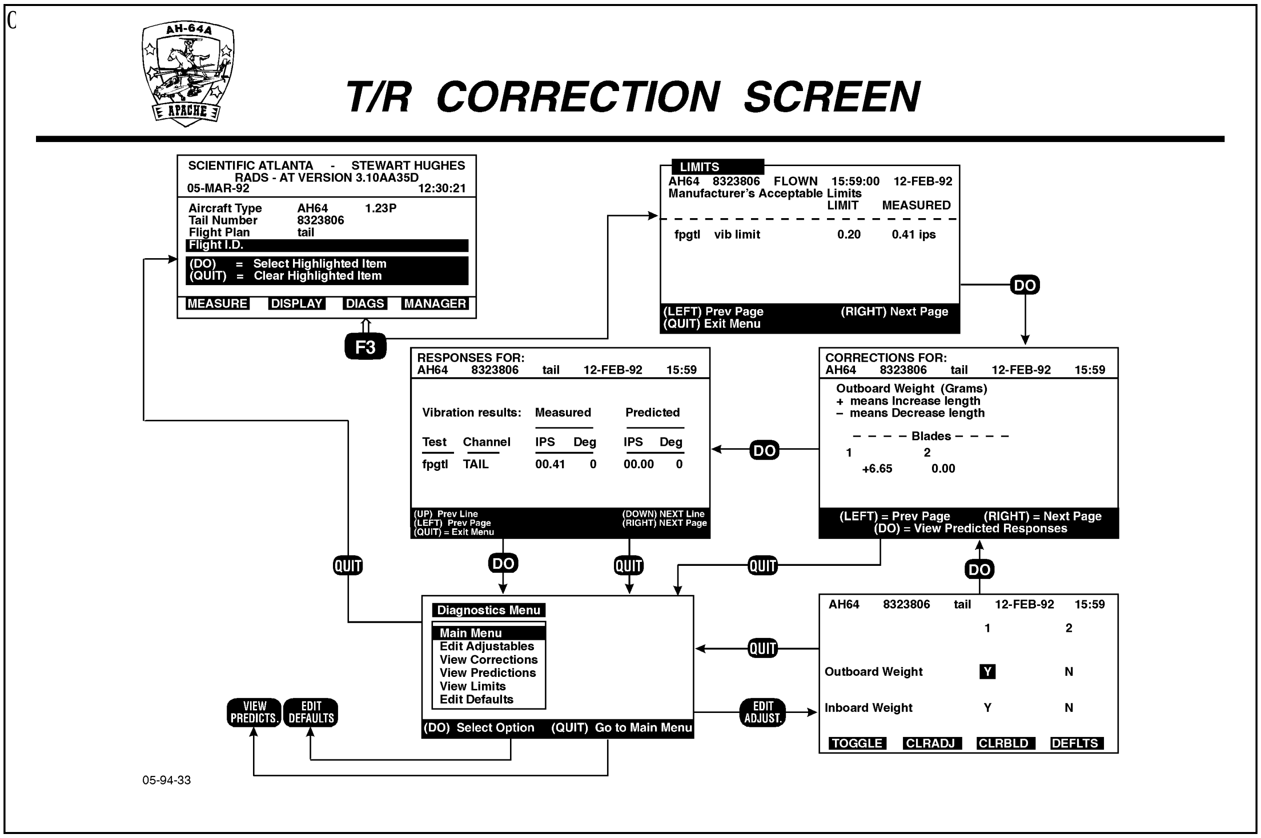
C

MEASURE MODE



NOTES

9. Press DO on the CADU when the pilot is stable at 100% Nr, flat pitch. Reverify pilot is at the required test state and press DO again. The AVA will acquire vibration data. The screen will display **MEASURING** while the unit is acquiring data. When vibration data is acquired the display will return to a selection display.



AH-64A
APACHE
T/R CORRECTION SCREEN
SCIENTIFIC ATLANTA - STEWART HUGHES
RADS - AT VERSION 3.10AA35D
05-MAR-92 12:30:21
Aircraft Type AH64 1.23P
Tail Number 8323806
Flight Plan tail
Flight I.D.
(DO) = Select Highlighted Item
(QUIT) = Clear Highlighted Item
MEASURE DISPLAY DIAGS MANAGER
F3
LIMITS
AH64 8323806 FLOWN 15:59:00 12-FEB-92
Manufacturer's Acceptable Limits
LIMIT MEASURED
fpgtl vib limit 0.20 0.41 ips
(LEFT) Prev Page (RIGHT) Next Page
(QUIT) Exit Menu
DO
RESPONSES FOR:
AH64 8323806 tail 12-FEB-92 15:59
Vibration results: Measured Predicted
Test Channel IPS Deg IPS Deg
fpgtl TAIL 00.41 0 00.00 0
(UP) Prev Line (DOWN) NEXT Line
(LEFT) Prev Page (RIGHT) NEXT Page
(QUIT) = Exit Menu
DO
CORRECTIONS FOR:
AH64 8323806 tail 12-FEB-92 15:59
Outboard Weight (Grams)
+ means Increase length
– means Decrease length
Blades
1 2
+6.65 0.00
(LEFT) = Prev Page (RIGHT) = Next Page
(DO) = View Predicted Responses
QUIT
DO
QUIT
QUIT
DO
Diagnostics Menu
Main Menu
Edit Adjustables
View Corrections
View Predictions
View Limits
Edit Defaults
(DO) Select Option (QUIT) Go to Main Menu
QUIT
AH64 8323806 tail 12-FEB-92 15:59
1 2
Outboard Weight Y N
Inboard Weight Y N
TOGGLE CLRADJ CLRBLD DEFLTS
VIEW PREDICTS.
EDIT DEFAULTS
EDIT ADJUST.
05-94-33

NOTES

10. After the last measurement is completed, press DO on "finish", press DO on "diagnostics". If the measurements are within specified limits, press QUIT to main menu and select next flight plan. If measured values exceed specifications, press DO to enter DIAGS mode.

11. If the results are less than 0.2 ips, no corrections are required. However the RAD-AT may offer corrections to smooth the rotor further, at the operators discretion.

12. If results exceed 0.2 ips enter the DIAGS mode and perform the corrections recommended by the correction screen. Be sure to make correction shown on both screens.

13. Repeat measurement to verify corrections.

14. Remove track and balance equipment.